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INTEGRATED NUCLEAR COMMUNICATIONS ASSESSMENT DATA BASE EVALUATION

Computer Sciences Corporation
6565 Arlington Boulevard
Falls Church, Virginia 22046

6 January 1978

Topical Report

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TOTAL	Data Base Specification

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A data base design for the INCA project is developed. The project requirements are used to develop a specification for an integrated data base system.

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EXECUTIVE SUMMARY

ES-I INTRODUCTION - THE INCA DATA BASE SYSTEM

As the scope and depth of Integrated Nuclear Communication Assessment (INCA) Program analyses have grown and the number of participants in the field has increased, so too have the demand for and the amount of technical data grown. Computer Sciences Corporation (CSC) was tasked with the responsibility of studying the demand and usage of INCA program data and recommending a data control/management system. The task required the design of an automatic data base system at the functional and detailed concept levels, and the following subtasks comprised the work breakdown structure:

1. Survey of data demand and usage
2. Preliminary design
3. System functional requirements and specifications
4. Detailed concept design.

The first two subtasks were iterative procedures in which the survey produced information suitable for a preliminary design. Questions raised during the preliminary design phase required further survey effort. The last two steps were not iterative but followed one another sequentially.

This report presents the background of the problem brought out by the survey, the purpose and objectives of the required data base system, and the design. For clarity and ease of understanding of the INCA data base architecture, a section on functional data base component fundamentals is also presented. This report also includes a basic INCA analysis support data base system established at the Reston facility (DCEC) of the Defense Communications Agency (DCA).

Appendix A of this report contains technical system information concerning a prototype INCA data base system used to test the concepts presented. Appendix B provides a tutorial section on data base concepts for the reader unfamiliar with such concepts.

ES-II BACKGROUND AND SURVEY RESULTS

A CSC survey of data requirements, data repositories, and data usage by the various INCA participants initiated this task. This survey took the form of comprehensive discussion, both in person and by telephone, with the INCA organizations as well as some organizations working in the nuclear effects field but not direct INCA participants. Since the efforts of both INCA and non-INCA participants are so interrelated and since INCA efforts could be expanded into some of the areas researched by non-INCA organizations, the decision was to have the data management system, hence the survey, encompass both classes of potential users. Table ES-1 gives the list of organizations contacted and whose data bases were surveyed. Figure ES-1 illustrates the relationship of the various data classification to the INCA data base system.

Table ES - 1. Data Base Survey (Page 1 of 3)

SERVICE OR COMPUTER PROGRAM (CUSTODIAN)	DESCRIPTION OF DATA SETS/FILES
INCAM-1 (BDM) ETC[3]	• Burst Parameters • Communications Sites • Table Look-Up
DASIAC (GE/ TEMPO)	• Phenomenology • Systems, Components, Materials • Keywords
NET-2 (BDM)	• Current Elements (Resistors, Capacitors) • Modelled Devices (Diodes, Transistors) • Microcircuits • System Elements
CIRCUS-2 (BOEING)	• Circuit Elements
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SERVICE OR COMPUTER PROGRAM (CUSTODIAN)	DESCRIPTION OF DATA SETS/FILES
APACHE SIMULATOR (GTE/SYLVANIA)	• Circuit and Trunk File
ROSCOE (GRC)	• Uplink and Downlink Parameters • Location Data • Nuclear Operation • Uplink and Downlink Scintillation • Dynamic Storage Allocation System

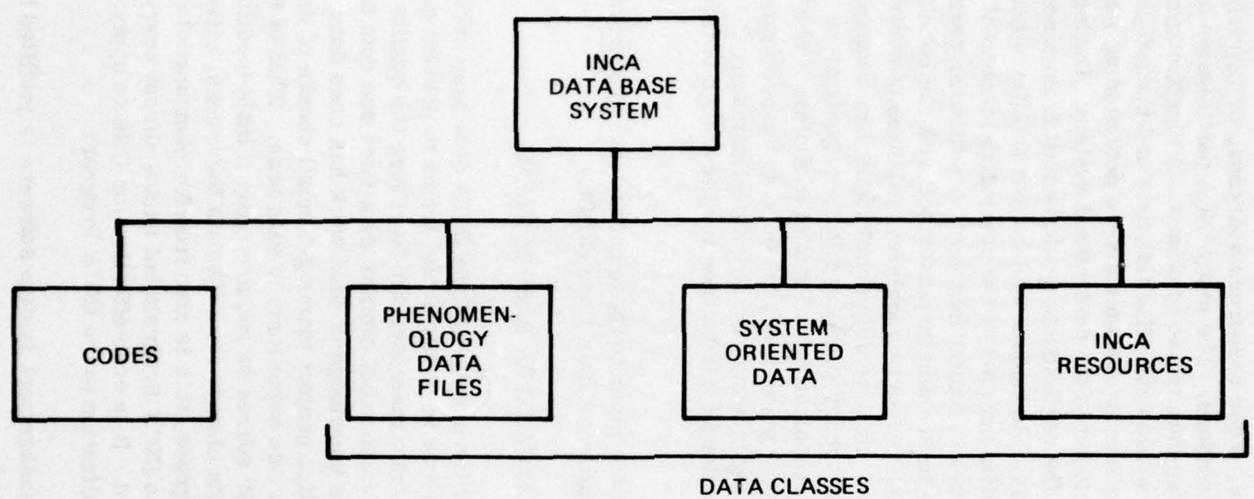

Figure ES-1.. INCA Data Classes

It became apparent during this survey that two data base systems were necessary, one which supports the technical analysis and another to provide a capability for literature, applicable codes, other resources searches, or inquiries. The first data base system was the more obvious. The many INCA participants are using common data and some are generating data of use to others. A single common technical analysis support data base would centralize this data and make technical data elements available to all users. The survey concentrated on determining what data elements and data files should be included in the centralized system. During this survey, it was also apparent that many of the participants would benefit from a second data base system called a resources data base. Redundant data collection efforts could be reduced or eliminated in the areas of data not part of the centralized technical analysis support data base. Keyword searches to locate data sets, documents, personnel expertise, etc., in the nuclear effects field could be performed with the benefit of focusing attention more quickly on the resource required. Addition of contracts, agency, nuclear effects organization, etc., would permit inquiry in a variety of ways suitable to both the Defense Nuclear Agency (DNA) and INCA organizations (e.g., which codes were developed by a given organization). Prime beneficiaries are new DNA contractors which could readily assess the prior research done and concentrate on building from this point rather than starting in a manner which duplicates previous efforts. The survey, therefore, included a collection of information for the design of this second data base system.

Formal names have been given to these data bases: Technical Analysis Support Data Base (TASDB) and Resources Data Base (RDB).

ES-III PURPOSE OF THE INCA DATA BASE SYSTEM

The single reason for the creation of the INCA data base system is the centralization of currently developed data in highly useful forms to prevent duplication of effort on the part of INCA Program team members and to ensure the quality of data used for INCA efforts. Currently, various but similar data files and data bases are being developed by contractors with little knowledge of what work has been done toward creating their required data. Usually, project teams get small chunks of data from various sources and integrate them into some form of data base. What is finally developed is often available from another source or requires only a little modification to make it readily useable. This exists clearly for DCA data for trunks, circuits, links, equipments, etc. In varying degrees, this is also true for phenomenology data. The problem is not unique to the INCA Program but exists almost everywhere in the information technology field. It is cost-effective for DNA to apply data base technology and the discipline of centralization to the INCA Program.

Usage of data base management system software is justified by several conditions:

1. The large volume of data with element redundancy (excess storage required) and record interrelationships

2. A sizable number of users (especially under separate authority)
3. The need for a single point of data management
4. The security/access control to data elements
5. Multiple, simultaneous users of the data.

Paragraph ES-II - Background and Survey Results reveals that these conditions justifying the use of data base management system (DBMS) software have been met. Multiple simultaneous users do not exist now since each organization has its own data copies. However, in a centralized operation, there will be multiple simultaneous users and, hence, there will be additional requirements for controlling and synchronizing their activities on the data base. DBMS software has provision for permitting multiple simultaneous users to access a common data base.

ES-IV OBJECTIVES OF THE INCA DATA BASE SYSTEM

There are many specific objectives which could be cited for the INCA data base system design once it has been established that the purpose for creating such a data base is feasible and appears cost-effective. However, for the initial concept work presented in this report, there will be only six specific objectives as described below.

Flexibility of the architecture permits additions and integration of new data as users find the INCA data base system useful and as they have other data relatable to the current content. This will be a necessity for the Automated Assessment Tool (AAT) which will be evolving over the next years and, consequently, will have changing requirements for additional data integration.

Flexibility of the architecture for data base reorganization is important since the usage patterns of the data base and the internal files are undefinable at this time. Gross tuning and later fine tuning will be required to ensure rapid retrieval and to minimize computer resources in terms of Central Processing Unit (CPU) time and disk seek times. New chains may have to be added to facilitate new data relationships which will be identified in the future. Without such chains, data base operations might consume a disproportionate or unnecessary amount of CPU resources.

Ease of use for many standard reports is a specific objective which has two issues. One is architectural, requiring that common data relationships be identified and chains of record pointers established to permit all request-relevant data be immediately and directly available without significant sorting and extracting. The other is implementation of a simple user report generator which can permit nonprogrammers to develop reports from the data base.

Ease and assurance of data maintainability are influenced partly by architectural and partly by management philosophy (ensuring that maintenance is done in order to assure data quality).

Finally, there must be a means to distribute the data base to users, either as remote or local batch usage of the data base on one computer or through the use of tape/disk distribution to users for their own computer systems.

These specific objectives are to be met mostly through the functional and detailed design efforts. While the foregoing is a reasonably modest set of specific objectives imposed on the INCA data base system, subsequent contractual work and use of early implementation will achieve even more.

ES-V INCA COORDINATED DATA ENVIRONMENT

Figure ES-2 illustrates the order and control over data sources and data quality made possible with a centralized data base management system. Within is the figure encompassing all aspects of the INCA Program, the shaded area separates the human aspects from the automated aspect of the total INCA system.

Starting at the top in the shaded area is the DNA Project Office - INCA Program. This office, through contractual instruments, authorizes INCA participants to become users of the INCA data base system. Application software, specific to the analysis to be performed, is developed by the users; this is the tool which the user employs to enter the data base system. The software may be used to reference standalone data sets (files) which are primarily phenomology-oriented data or procedures to involve codes on the computer. It may also interface to either of the two data bases established. Interface is through the DBMS which accepts a list of data elements to be referenced or updated, etc.

In the unshaded area is the data base system consisting of:

1. The data base administrator who receives user authorization from the DNA Project Office and general guidance as to how the data base is to be used
2. The DBMS with the two data bases, TASDB and RDB, as well as a data dictionary
3. A nuclear codes library
4. Standalone data sets.

Users' procedures and applications programs are utilized to reference the codes library and standalone data sets as provided by the standard computer operating system. User application programs access the two data bases and data dictionary (if provided) through the DBMS. It controls user access to read, write, add, and delete data elements; users may be authorized for one or several of the options by the Data Base Administrator.

The Data Base Administrator is the most important human element of the INCA data base system. He is the one who ensures that all necessary steps are taken to:

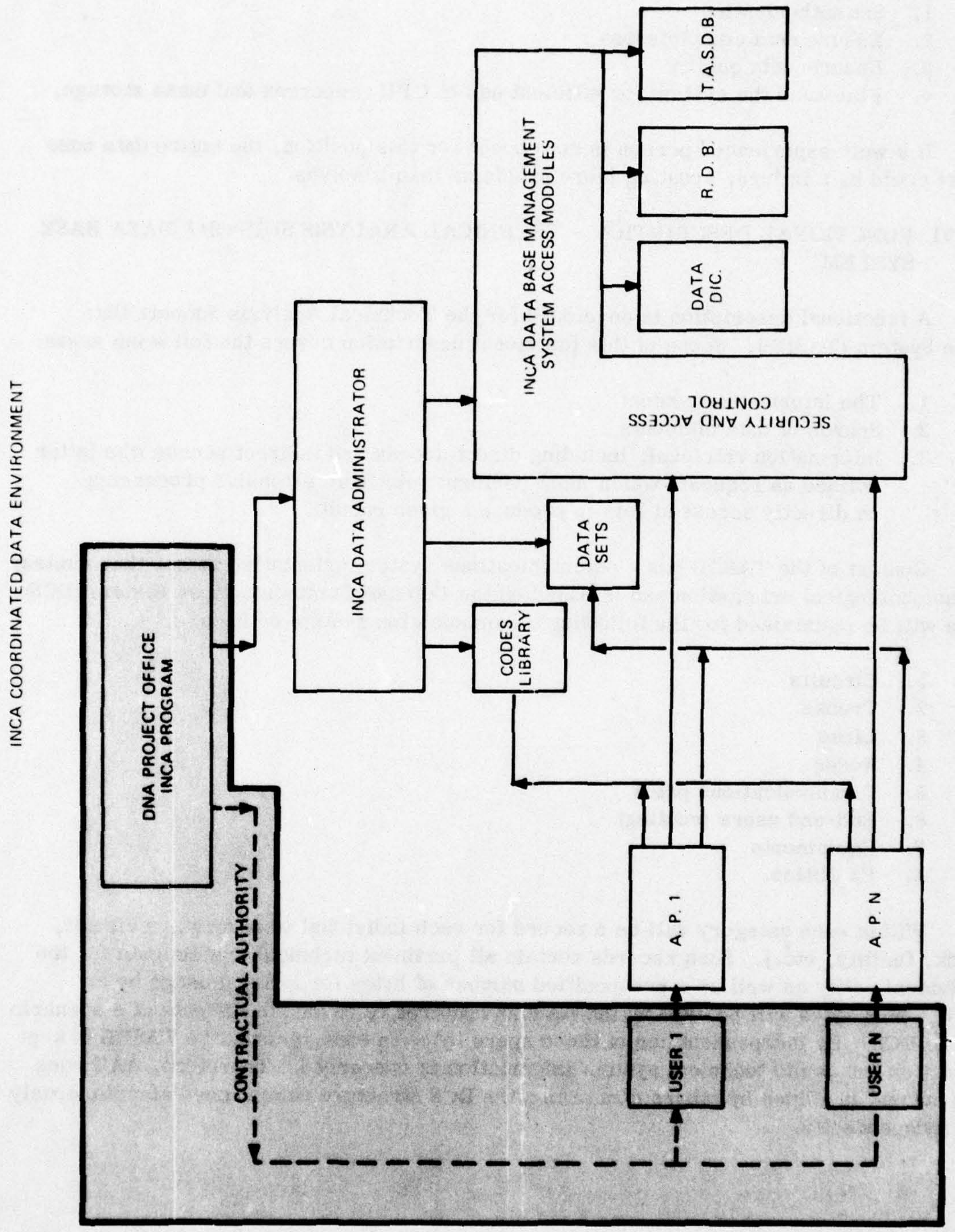

Figure ES-2. INCA Coordinated Data Environment

1. Set authorization
2. Ensure data completeness
3. Ensure data quality
4. Fine-tune the system for efficient use of CPU resources and mass storage.

If a well-experienced person is not chosen for this position, the entire data base effort could be a failure, creating more problems than it solves.

ES-VI FUNCTIONAL DESCRIPTION - TECHNICAL ANALYSIS SUPPORT DATA BASE SYSTEM

A functional description is developed for the Technical Analysis Support Data Base System (TASDB). Scope of this functional description covers the following areas:

1. The information content
2. Source of data elements
3. Information retrieval, including direct access and indirect access (the latter defined as requests which must perform relatively extensive processing on directly accessed data to produce a given result).

Content of the TASDB has a communications system orientation rather than nuclear phenomonological orientation and is based on the Defense Communications System (DCS). Data will be maintained for the following communication system entitles:

1. Circuits
2. Trunks
3. Links
4. Nodes
5. Communications paths
6. End-end users (routing)
7. Equipments
8. Facilities.

Within each category will be a record for each individual item (e.g., a circuit, trunk, facility, etc.). Such records contain all pertinent technical system data for the individual entity as well as a prespecified number of bytes for general usage by an AAT. Such bytes will be used by the AAT as required to record the effects of a scenario on the DCS. By independent use of these spare bytes in each record, the TASDB is kept in tact as far as the technical system information is concerned. Therefore, AAT runs and normal inquiries by others concerning the DCS structure can proceed simultaneously but independently.

ES-VII DETAILED DESIGN SPECIFICATION - TASDB

A detailed conceptual design specification was developed for the TASDB. It includes:

1. Specifications of master and variable files
2. Record formats
3. Record pointers and chains
4. CPU memory requirements.

Figure ES-3 illustrates the TASDB architecture.

ES-VIII PROTOTYPE INCA TECHNICAL ANALYSIS SUPPORT DATA BASE

To test out the concepts developed for the INCA TASDB, and also to support the Trunk Allocation Task, a small data base was established under the TOTAL DBMS on an IBM-370/155 at DCA in Reston, Virginia. Its primary content is a representative set of circuits between the U.S. and Europe, as well as in Europe. Included are all related records for circuits, trunks, links, and sites/nodes. Access to the data base permits inquiries to show all circuits contained in a given trunk, shows all trunks and associated circuit file for trunks passing through a given node, etc.

The results of the Trunk Allocation Task were formally briefed to DNA and the results were supported by the data base usage. If it had not been developed, repetitive sorting would have been required to align records from one file to those of other related files as well as to write edit/select utilities to extract the desired data from sorted files. Use of this data base proved the utility and benefits of the INCA TASDB for the INCA Program. It was consequently used as the nucleus of the larger, more comprehensive TASDB. Refinements to this prototype were made prior to using it as a nucleus to the TASDB. Figure ES-4 illustrates the prototype TASDB architecture.

ES-IX FUNCTIONAL DESCRIPTION - RESOURCES DATA BASE SYSTEM

A functional description was developed for the RDB. The scope of this functional description covers the following areas:

1. Definition of the data base files with regard to information content
2. Information access capabilities and limitations.

The RDB is the library information retrieval subsystem of the INCA data base system. It catalogs reference information concerning the INCA program, including codes, contracts, documents, etc. With the RDB, automated information reference regarding previous technical efforts and available resources is made readily available to INCA participants. The internal RDB architecture will be designed with maximum flexibility to ensure adaptibility to new types of INCA reference and resource categories as the INCA Program develops.

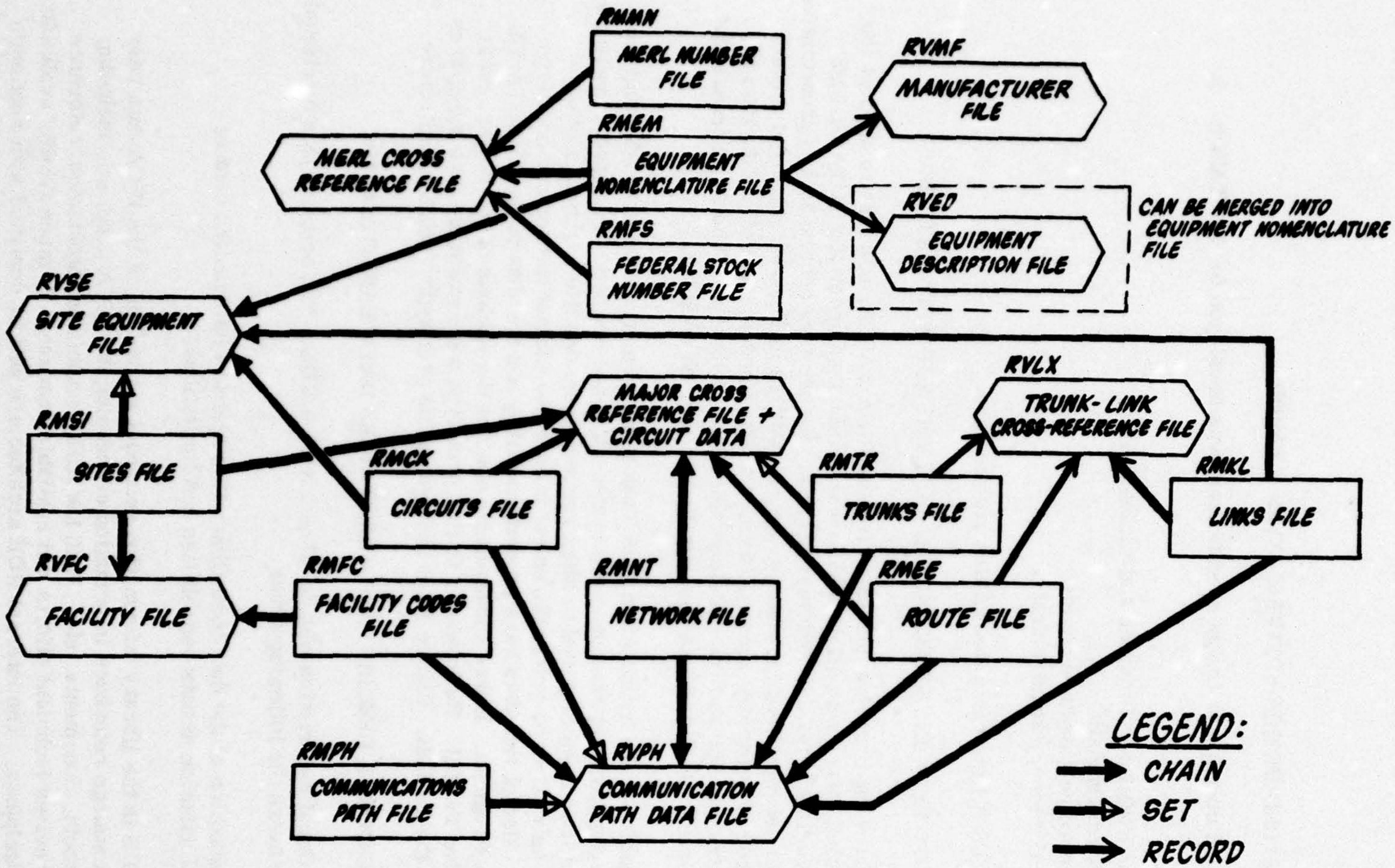

Figure ES-3. INCA Technical Analysis Support Data Base Architecture

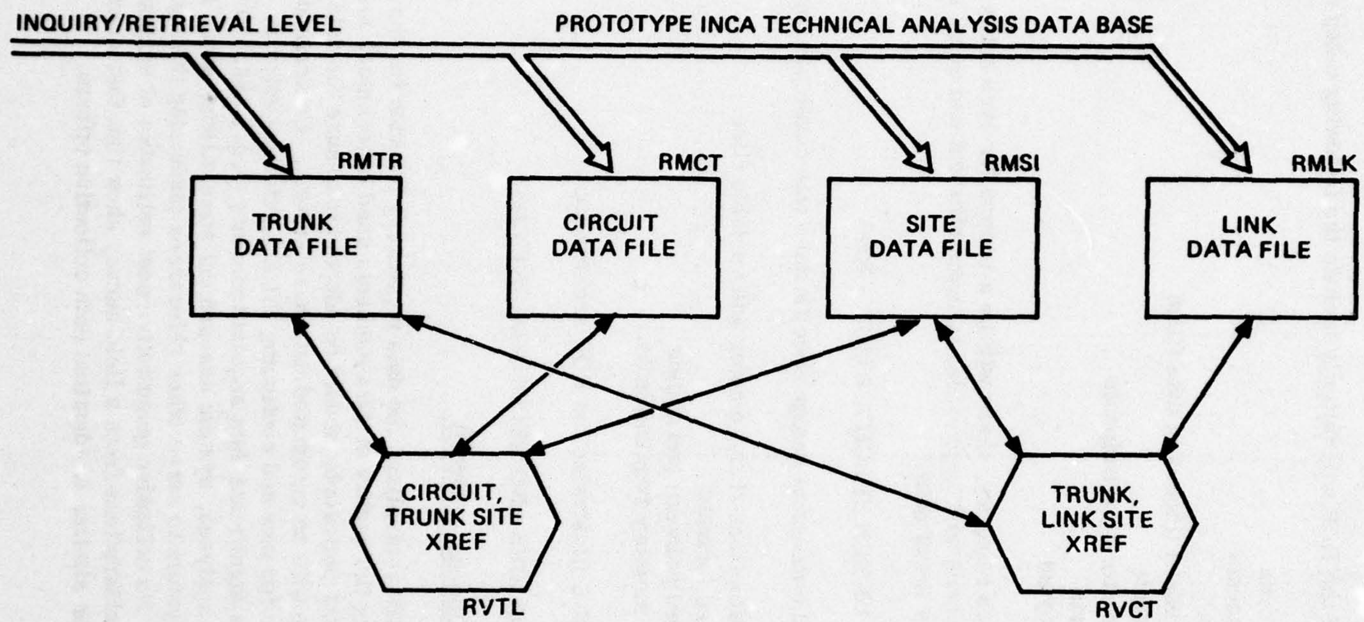

Figure ES-4. Prototype INCA Technical Analysis Data Base

Content of the RDB will initially include the following categories:

1. Keywords
2. Documents
3. Codes
4. Data bases (including data files)
5. Contracts
6. Contractors/participants
7. Experts
8. Acronyms

Within each category, there will be a record for each entity. Linkage between interrelated records will be provided to make efficient and quick access to related information as a set of data.

ES-X DETAIL DESIGN SPECIFICATION - RDB

A detailed conceptual design specification was developed for the RDB. It includes

1. Specifications of the master and variable files
2. Record formats
3. Record pointers and chains
4. CPU memory requirements.

Figure ES-5 illustrates the RDB architecture.

ES-XI CONCLUSIONS AND RECOMMENDATIONS

ES-XI.1 Conclusions - TASDB

The TASDB centralizes the data repository function for the INCA Program as well as ensuring the quality of data elements used in technical analyses. A strong data base management philosophy should be adopted to assure the data completeness and quality possible with an automated data base system. Centralization reduces costs of data acquisition for new and continuing INCA participant efforts. Currently, as each new project has significant data acquisition costs (e.g., $50,000 to $250,000), new data is produced by analyses, system assessment simulations, etc., it will be fed back into the data base system to serve other references (assuming the results are of general applicability). No definitive quantitative cost estimates of savings were made, but qualitative considerations from a field survey show that there currently are repetitive expenditures for similar or identical data collection efforts.

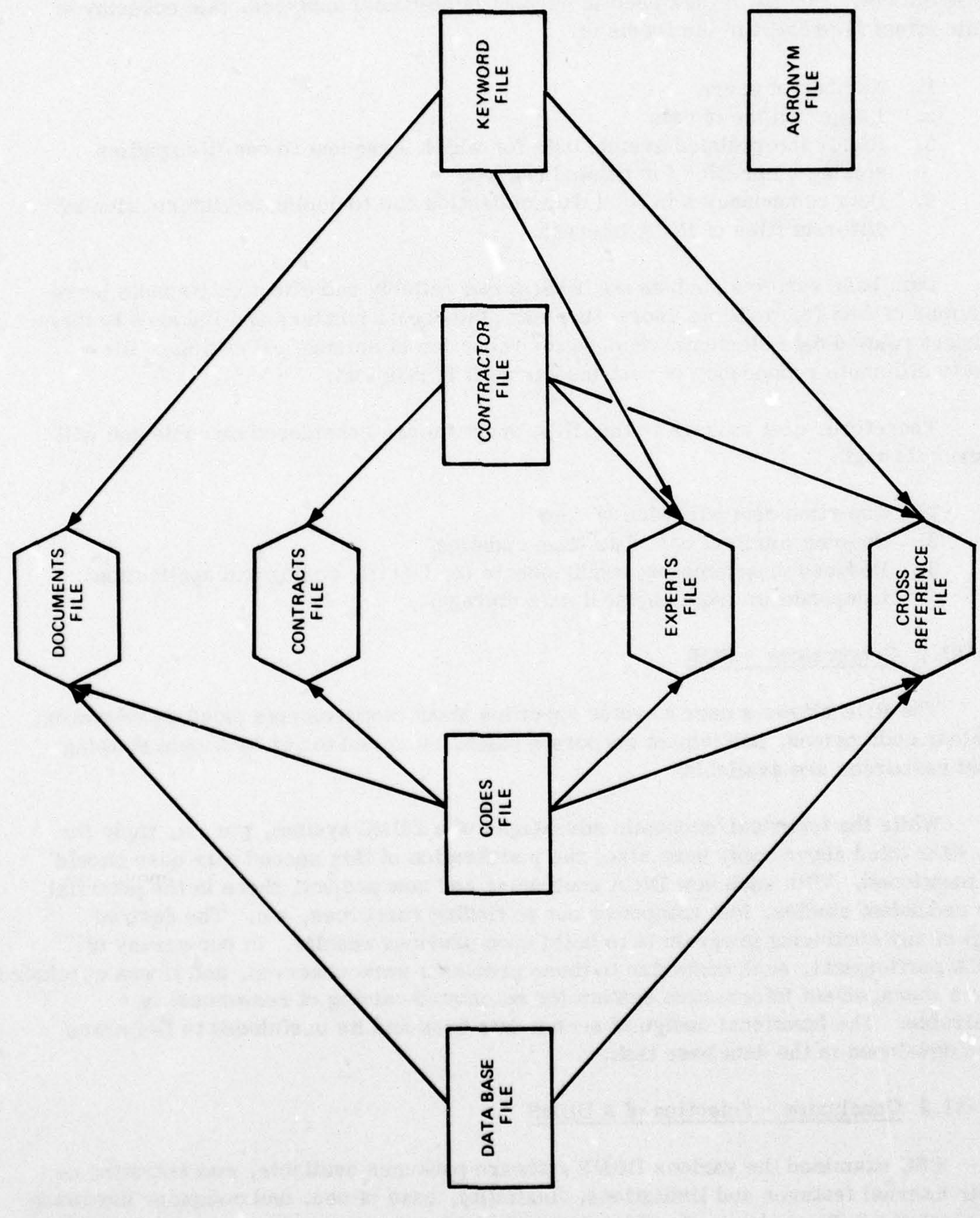

Figure ES-5. Resources Data Base

Automated data base systems offer cost savings primarily through economy of scale effects. For INCA data used in support of technical analyses, this economy of scale effect is present in the forms of:

1. Number of users
2. Large volume of data
3. Highly interrelated system data for which a request to one file implies sorting other files for related records
4. Data redundancies in total data collection due to duplicated information in different files of INCA interest.

Data base systems such as the TASDB can reliably and effectively handle large volumes of data for multiple users; they can also create pointers and linkages to interconnect related data elements/records for reduction of sorting and sifting of files and to eliminate redundancy of data insofar as it is efficient.

Therefore, cost savings to the INCA program are considered sizeable and will accrue through:

1. One-time centralization of data
2. Ongoing minimal cost data base updating
3. Reduced programming requirements (no I/O file coding and application independence from physical data storage).

ES-XI.2 Conclusions - RDB

The RDB allows a user to enter specifics about requirements (such as keywords, nuclear code names, participant corporate name, etc.) and to get back data showing what resources are available.

While the technical/economic advantages of a DBMS system, per se, apply for the RDB cited above apply here also, the justification of this second data base should be mentioned. With each new INCA contractor and new project, there is the potential for redundant studies, lost manpower due to finding resources, etc. The desired goal of any continuing program is to build upon previous results. In our survey of INCA participants, such costs due to these problems were observed, and it was concluded that a management information system (or automated catalog of resources) is desirable. The functional design of such a data base and its usefulness to INCA was then developed in the data base task.

ES-XI.3 Conclusion - Selection of a DBMS

CSC examined the various DBMS software packages available, concentrating on their internal features and limitations, flexibility, ease of use, and computer hardware on which the S/W can be used. Comparisons of these facets were measured against

the Government-furnished DBMS (called TOTAL and marketed by Cincom Systems, Inc.). TOTAL was furnished to CSC as operational on the IBM-370/155 at the Reston, Virginia, DCA. It was used for the Trunk Allocation Task and for the prototype INCA data base effort. Two questions were to be answered by the selection process: In the absence of any Government-furnished DBMS, which DBMS would be best for the INCA program? If TOTAL, as provided by the Government, was to be continued, are there any possible reasons to suggest its replacement by another DBMS?

The answer to both questions is TOTAL as DBMS. It is the best available package since it:

1. Is transportable to IBM, Honeywell, CDC, and many minicomputers in Government inventory
2. Interfaces to standard programming languages
3. Is easily used
4. Has great flexibility to cost-effectively handle INCA Program emphasis changes
5. Is widely accepted by computer industry
6. Has good vendor support
7. Has continued development of online, inquiry, and utility S/W modules.

After the elimination of certain inadequate vendors, those examined were:

1. System 2000
2. IMS
3. Model 204
4. IDMS
5. ADABAS.

System 2000 would be the next best choice if TOTAL did not exist.

ES-XI.4 Recommendations

CSC recommends that a final cost-benefit analysis be made to measure the data base system concepts and design generated against current and future INCA Program efforts. This is not anticipated to be either a lengthy or costly study, but rather to demonstrate clearly that the designed data base system is clearly cost-effective to implement at this time or at a later point in time.

Assuming that the analysis proves it is cost-effective to make this INCA program investment and at this time, CSC recommends that the DNA take strong action to establish the INCA data base system during the timeframe shown to be most cost-effective by the analysis either now or in the future.

We make this recommendation recognizing that the DNA and the INCA Program are long-term entities and, therefore, will be substantially involved in repetitive data collection and analysis of the identical or similar data, differing from INCA task-to-task only in its organization and usage.

ES-XII - DATA BASE TUTORIAL

Appendix B of the Final Report - Data Base Analysis - - provides the reader with a generic tutorial description of a DMBS. Data files, pointers, chains, and other related concepts are developed in a systematic manner to illustrate the use and benefits of a DBMS. It is highly recommended that readers unfamiliar with DBMS operation or structure review this appendix prior to reading the technical sections of the final report.

SECTION 1 - INTRODUCTION - THE INCA DATA BASE SYSTEM

As the scope and depth of INCA Program analyses have grown and the number of participants in the field has increased, so too has the demand for and the amount of technical data grown. CSC was tasked with the responsibility to study the demand and usage of INCA program data and to recommend a data control/management system. An automatic data base system was to be designed at the functional and detailed concept levels. The task work breakdown consisted of the following subtasks:

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In this report, the background of the problem as brought out by the survey, the purpose and objectives of the required data base system and the design are presented. A basic section on functional data base components is also presented for clarity and ease of understanding the INCA Data Base Architecture. A basic INCA Analysis Support Data Base System which was established at the Reston facility (DCEC) of the Defense Communications Agency is described.

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SECTION 2 - BACKGROUND AND SURVEY RESULTS

CSC started this task with a survey of data requirements, data repositories and data usage by the various INCA participants. This survey took the form of comprehensive discussions, both in person and by telephone, with the INCA organizations as well as some organizations working in the nuclear effects field, but which are not direct INCA participants. Since the efforts of both INCA and non-INCA participants are so inter-related and since INCA efforts could be expanded into some of the areas being researched by non-INCA organizations, it was felt that the data management system, hence the survey, should encompass both classes of potential users. Table 1 gives the list of organizations contacted and whose data bases were surveyed. Figure 2-1 illustrates the relationships of the various data classification to the INCA Data Base System.

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SERVICE OR COMPUTER PROGRAM (CUSTODIAN)	DESCRIPTION OF DATA SETS/FILES
APACHE SIMULATOR (GTE/SYLVANIA)	• Circuit and Trunk File
ROSCOE (GRC)	• Uplink and Downlink Parameters • Location Data • Nuclear Operation • Uplink and Downlink Scintillation • Dynamic Storage Allocation System

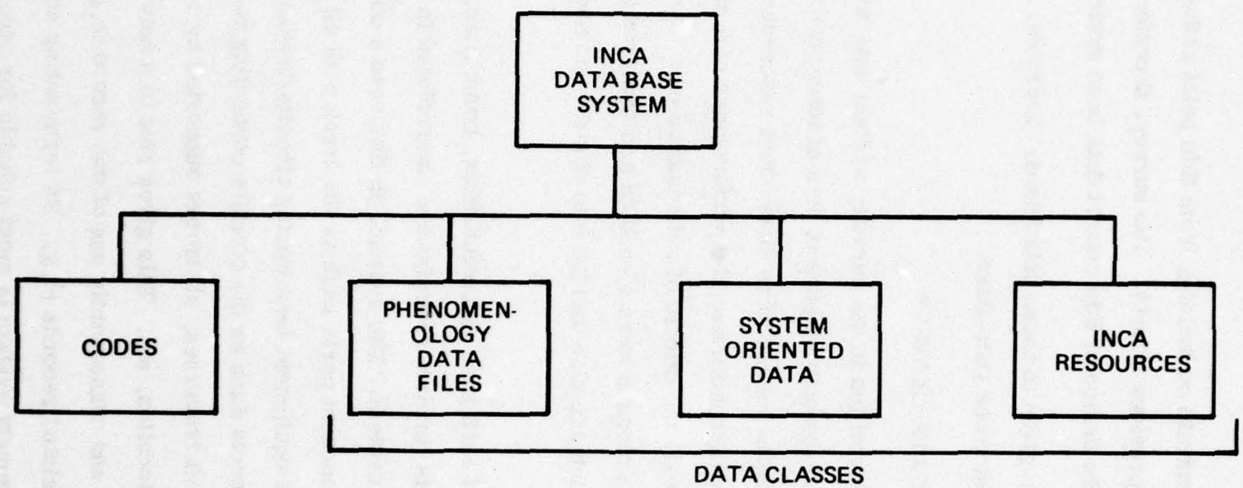


Figure 2-1. INCA Data Classes

prior research done and concentrate on building from this point rather than starting in a manner which duplicates previous efforts. The survey, therefore, included collection of information for the design of this second data base system.

Formal names have been given to these data bases: Technical Analysis Support Data Base and the second, Resources Data Base.

2.1 TECHNICAL ANALYSIS DATA CLASSES

Two data classes were identified in the survey: system data and phenomenology data. These are believed to be the only classes of data of interest to the INCA program and other nuclear effects researchers since most researchers study the nuclear effects of one or more detonations on the performance of a single communications link and a smaller set study the effects of a detonation on a total system which currently exists. Data in both classes were identified and analyzed as to how they are used by current codes which are also divided into system and phenomonology classes.

System data consisted of such files as circuit files, trunk files, link files, equipment files, etc. Such elements (or data records) are interrelated in describing an architecture, a complex or a system. The system, in this case a communications system, can be exploded into component parts such as the trunk with all its circuits connecting two geographic points, the equipment terminating circuits/trunks, etc. The "complex" may be studied from many aspects such as the circuits connecting two geographic points, all geographic points the circuit traverses, all trunks supported by a microwave tower at a given type for a specific location, etc. This gives rise to a network of relationships between distinct data records and consequently use of one record (e.g., a trunk record) may require locating all associated records (e.g., its terminating equipments, or its circuits). A data base management system is most suitable for accessing and controlling the data and its inter-relationship links. Inter-relationship links between distinct, but related, record types are called pointers and a series of pointers such as those linking all circuits to its given trunk record is called a chain. Use of such pointers or

chains makes rapid retrieval of related data possible without sorting or sequential search. It is also more efficient than a set of index-sequential files. Design of the data sets and records is the responsibility of the data base administrator and system design personnel. Management of data requests, control over pointer modification (e.g., as required in additions, deletions, etc.) is related to data base integrity and is the responsibility of a software package generically known as a data base management system (DBMS).

The other data class is sets of nuclear phenomenology data. Such data is used by a model input or generated as its output. Such data was found not to exhibit the same interrelationships as the system oriented data. This data involves first principles on the physics of the event. Individual physical effects usage is their chief characteristic. In terms of the INCA program, it is recommended that such data sets be centralized for ease of data distribution, but would be treated as stand-alone data files. Examples of such files are:

- Burst parameters
- Neutron, Beta and Gamma fractions
- Ground loss coefficients
- Fireball and debris properties
- Others

2.2 RESOURCES DATA CLASS

There is but one class of data for cataloging INCA program resources. It is subdivided into data files similar to the subdivision of system data (described above) into circuit file, trunk file, equipment file, etc. Subdivisions of this data class are:

- Keywords
- Documents
- Codes

- Data Bases/Sets
- Contract
- Contractors/Participants
- Experts

Examination of available resources and discussions with INCA and non-INCA participants showed these subdivisions to be entirely adequate to provide information or source on any resource required. A description of the subdivisions is not necessary since the content of each is self-explanatory by the title. A very significant amount of inter-relationships between subdivisions exists. For instance, a contract record could be interlinked to all document records for documents produced under the contract. Similar record interlinking could occur for codes, data bases, etc. A given company name and address would appear in many records and could be condensed to a reference to the contractors/participant file. Inquiries would reference one file (e.g., contract number) and then attempt to locate all documents, codes, etc., developed under that contract number or using a keyword, enter that file and attempt to locate all codes or data file references in the appropriate Codes or Data Base/Sets file.

As with the system data, there will be a series of pointers or data chains which will "a priori" set up all the meaningful relationships that inquiries would require. Management of these chains and as a result, assured data base integrity, can only be provided by a data base management system. Therefore, a DBMS is recommended for the Resources Data Base. It is to be noted that this is a second data base system maintained entirely separate from the system data base.

2.3 BACKGROUND AND SURVEY SUMMARY

In summary, it was found that two data bases are required. One is used to maintain system data for technical analysis and simulation efforts such as the assessment tool, while the second is a library-oriented data base for inquiry about resources available. Standard phenomenology data is best kept as individual data sets co-located at one centralized source under a computer system data librarian function. Codes will

be maintained in standard computer program library formats for source and object versions. Collectively, these elements constitute the INCA Data Base System.

It is recommended that all four elements cited above be maintained at one central facility to ensure data distribution and quality control. Distribution can take the form of remote usage of the central facility (assuming appropriate crypto and security measures are available) as well as batch processing at the central facility. For local usage by contractors, copies of the data bases, data sets, codes, etc. can be provided on magnetic tape or disk.

SECTION 3 - PURPOSE OF THE INCA DATA BASE SYSTEM

A single reason exists for the creation of the INCA Data Base System: centralization of currently developed data in highly useful form to prevent duplication of effort on the part of INCA contractors and to ensure the quality of data used for INCA efforts. Currently, various but similar data files and data bases are being developed by contractors with little knowledge of what work has been done toward creating their required data. Usually, contractor personnel get small chunks of data from various sources and integrate it into some form of data base. What is finally developed is often available from another contractor or requires only a little modification to make it readily useable. This exists clearly for the DCA data for trunks, circuits, links, equipments, etc. In varying degrees, this is also true for phenomenology data. The problem is not unique to the INCA program, but exists almost everywhere in the information technology field. It is cost-effective for DNA to apply data base technology and the discipline of centralization to the INCA program.

Usage of data base management system software is justified by several conditions:

- Large volume of data with element redundancy (excess storage required) and record interrelationships
- More than a few users (especially under separate authority
- Need for single point of data management
- Security/access control to data elements
- Multiple, simultaneous users of the data

These conditions which justify the use of data base management system software were shown to be met as outlined under Section 2 - Background and Survey Results. Multiple, simultaneous users do not exist now since each organization has its own data copies. However, in a centralized operation, there will be multiple, simultaneous users and hence, the additional requirement for controlling and synchronizing their activities

on the data base arises. DBMS software has provision for permitting multiple, simultaneous users to access a common data base.

SECTION 4 - OBJECTIVES OF THE INCA DATA BASE SYSTEM

There are many specific objectives which could be cited for the INCA Data Base System design once it has been established that the purpose of creating such a data base is feasible and appears cost-effective. However, for the initial concept work presented in this report , six specific objectives were established and are described below.

Flexibility of the architecture permits additions and integration of new data as users find the INCA Data Base System useful and have other data relateable to the current content. This is a particular necessity for the Automated Assessment Tool (AAT) which will be evolving over the next years and consequently, will have evolving requirements for additional data integration.

Flexibility of the architecture for data base reorganization is important since the usage patterns of the data base and the internal files are undefinable at this time. Gross tuning and later fine tuning will be required to ensure rapid retrieval and to minimize computer resources in terms of CPU time and disk seek times. New chains may have to be added to facilitate new data relationships which are identified in the future. Without such chains, data base operations might consume a disproportionate or unnecessary amount of CPU resources.

Ease of use for many standard reports is a specific objective which has two issues. One is architectural which requires that common data relationships be identified and chains of record pointers be established to permit all data relevant to a request to be immediately and directly available without significant sorting and extracting. The other is implementation of a simple user report generator which can permit non-programmers to develop reports from the data base.

Ease and assurance of data maintainability is partly architectural and partly a management philosophy (which ensures the maintenance is done in order to assure data quality).

Lastly, there must be a means to distribute the data base to users either as remote or local batch usage of the data base on one computer or through the use of tape/disk distribution to users for their own computer systems.

These specific objectives are to be met mostly through the functional and detail design efforts. While the foregoing is a reasonably modest set of specific objectives imposed on the INCA Data Base System, subsequent contractual work and use of early implementation will produce further objectives.

SECTION 5 - INCA COORDINATED DATA ENVIRONMENT

A data base system interfaces people and data in a single environment.

Figure 5-1 shows the relationship of DNA, the INCA participants, the INCA Data Administrator and the INCA data. This system level schematic applies to both the INCA Resources Data Base and the INCA Technical Analysis Support Data Base.

The shaded area of Figure 5-1 contains the human elements of the system which are DNA and the data base users authorized by DNA. At the top of the system is the DNA Project Office/INCA Program. All policy decisions regarding data base user authorization, data bases maintained/data content which should be available to further quality technical analyses, specific directives as to what data sources may be used to establish or increase data holdings are made at this level. Two lines of authority flow from this level: one to authorize INCA participants to use the data base and the other to the INCA Data Administrator who is the guardian of the INCA Data Base System.

Users (represented in the shaded area) use application software (real-time or batch) to access the INCA Data Base System for data retrieval. There are three categories of information which can be retrieved and three mechanisms are utilized. Codes are stored within the computer operating system program library and are retrieved (or executed) according to operational procedures of the operating system. Data sets contain look-up tables, parameters sets and other data not oriented toward a record-record relationship between data files. These are also accessed according to standard operating system procedures. Application programs are required for this type of access. Data base system controlled files are accessed by the users applications programs, but, unlike data sets, the application programs are not required to be coded with awareness of what record formats are or provide logic to correlate records (e.g., all circuits records of the circuit file with the trunk record of the trunk file). The DBMS has all such formats, relationships, etc., built in.

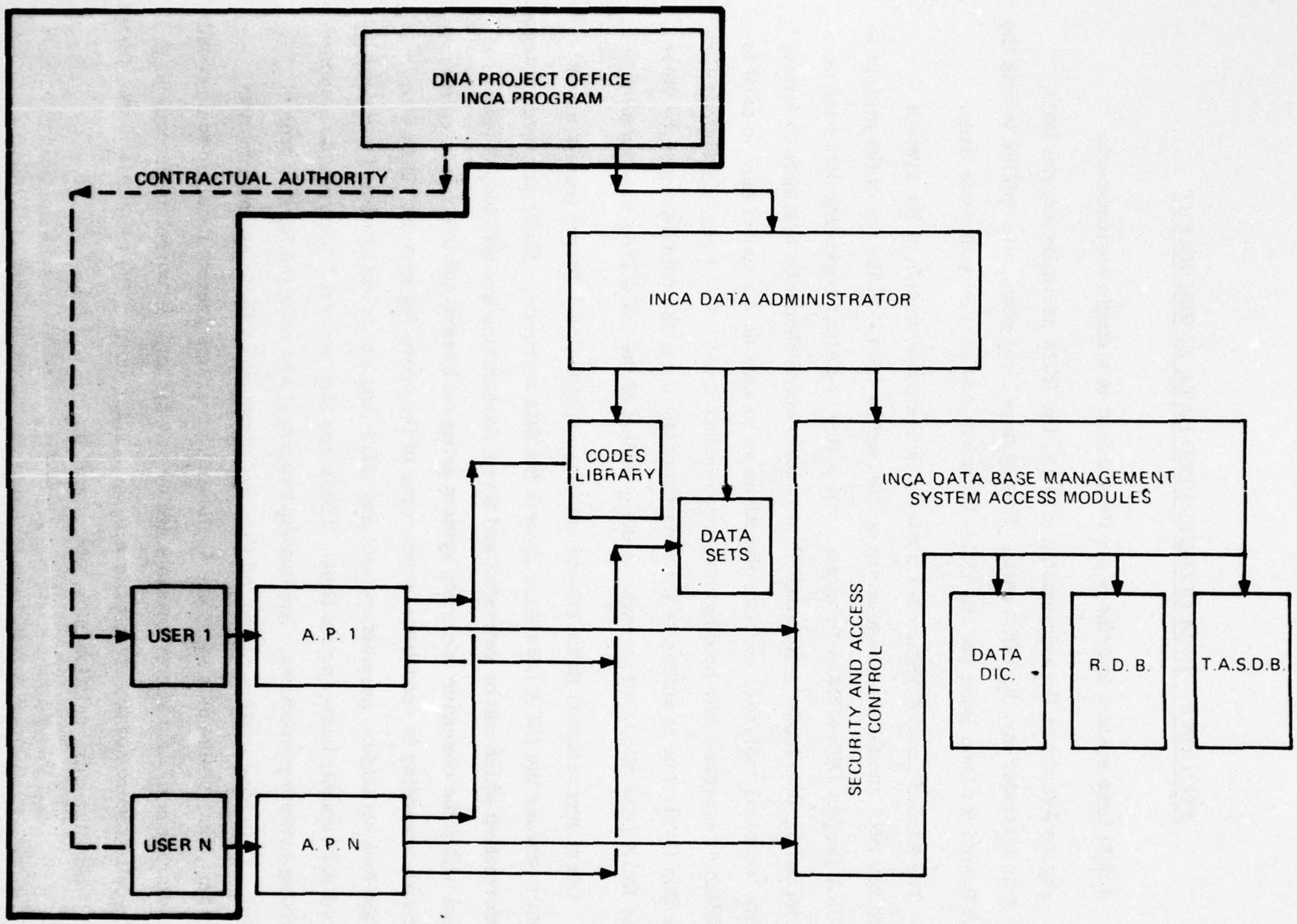


Figure 5-1. INCA Coordinated Data Environment

The second line of authority from the DNA Project Office flows to the INCA Data Administrator. This individual can be either a DNA staff member or a contractor staff member if a contract is issued for maintenance and operation of the INCA Data Base System.

Responsibilities of the INCA Data Administrator are:

- Establish the data base
- Control the quality of data from supplier sources
- Ensure a timed system which is efficient in terms of data retrieval and updating
- Control passwords and other security aspects of the INCA Data Base System.

Users will have little interaction with the data administrator. His prime interaction (and that of his system staff) is with the DBMS and the data files. As the INCA program evolves and/or changes emphasis, the nature of the retrievals will change and most likely the organization of the data base itself. This results in re-tuning the system by modifying the number of pointers (new record relationship), reorganizing the data files or changing the physical storage units. Other aspects of the responsibilities as given above are self-explanatory.

The unshaded area of Figure 5-1 illustrates the data base system itself. It is composed of the DBMS software package, a data dictionary and the data files used for the two data bases of the INCA program.

All user application programs interface to the data base by means of the DBMS. Lists of data elements, action to be performed, etc., are passed from the application program to the DBMS. If the action requested by the user is authorized (determined from user characteristic tables), the DBMS performs the indicated retrieval or update and passes the results back to the user application program. Therefore, there is the interface and security check subsystem as well as a file access area within the DBMS.

The above make up the totality of the dynamic INCA Data Base System environment.

SECTION 6 - FUNCTIONAL DESCRIPTION - TECHNICAL ANALYSIS

This section sets forth the functional description of the Technical Analysis Support Data Base System (TASDB). Scope of this functional description is extended to the following areas.

- Information content of the Technical Analysis Support Data Base (TASDB)
- Source of Data Elements
- Information retrieval including direct access and indirect access (the latter being defined as requests which must perform relatively extensive processing on directly accessed data to produce a given result).

A detail design specification in this report presents the data files, inter-file linkages, records formats, etc., as would be required to implement the TASDB.

6.1 CONTENT OF THE TASDB

Content of the TASDB has a communications system oriented rather than nuclear phenomonological orientation. Data shall be maintained for the following communication system entities:

- Circuits
- Trunks
- Links
- Nodes
- Communications paths
- End-end users
- Equipments
- Facilities

Within each entity category will be a record for each individual item (e.g., a circuit, trunk, facility, etc.). Such records contain all pertinent technical system data for the individual entity as well as a pre-specified number of bytes for general usage by an Automated Assessment Tool (AAT). Such bytes will be used by the AAT

as required to record the effects of a scenario on the Defense Communications System. By independent use of these spare bytes in each record, the TASDB is kept in tact as far as the technical system information is concerned. Therefore, AAT runs and normal inquiries by others concerning the DCS structure can proceed simultaneously, but independently.

6.1.1 Circuit Data

Circuit data maintained and accessible in the TASDB will include data as generally found in the DCA Circuit File and described by DCA circular 365-10-1.

6.1.2 Trunk Data

Trunk data contained within the TASDB will include data elements as generally found in the DCA Trunk File and which are fully described in DCA Circular 310-65-1.

6.1.3 Link Data

Link data contained within the TASDB will include data elements as generally found in the DCA Links File which are fully described in DCA Circular 310-65-1.

6.1.4 Nodes Data

Data maintained for each node (switch site, microwave tower site, and user site etc.) will include the following elements:

1. Abbreviated geographic on-site name (according to DCA abbreviation conventions)
2. Full geographic spelling of the above name
3. Full spelling of geographic location
4. DCA area code
5. DCA county/state codes
6. Latitude/longitude
7. Principal functional use of site (e.g., AUTODIN switch)

8. Secondary functional use of site

9. Territory function use of site (other levels may be added)

10. Site plan number

11. Site plan location

6.1.5 Communications Path Data

While a circuit describes the communications path from one geographic point and end user to another, the communication path will describe the path of the circuit in detail. Path data begins with the main distribution frame or tech control at one site and traces the circuit through other facilities, cables, trunks, links, etc., to the destination main distribution frame, tech control or other termination point. Circuit data maintained in the TASDB and cited above only describes the circuit end-to-end parameters as a summary of the end-to-end capabilities of the circuit but does not show the detailed flow of the circuit through facilities, cables, trunks, etc., as does the communications data. It is possible for several circuits to have the exact identical path. Therefore, several circuit CCSD numbers of the circuit data will point to the same path number when the path is identical for those several circuits.

Data elements for the communication path data have been developed by Computer Sciences Corporation using the DCA circuits, trunks and links file plus the MERL equipment files.

6.1.6 Equipment Data

Equipment data is drawn from the DCA MERL Equipment file and organized to fit the requirements of the TASDBin order to relate equipment to nodes, circuits, trunks and links.

6.1.7 Facilities Data

Facilities data is similar in nature to that found in DCA Circular 365-10 and as used in the DCA files. Data elements included are:

- Facility code
- Full spelling of facility name/type
- Links to where these facilities are used on circuits, trunks, links or in nodes.

6.2 ORGANIZATION OF TASDB

The organization of the TASDB is that of a plex or network structure rather than tree (heirarchical) or relational data base organizations. Relational data base organization is mostly theoretical work at the present time and is ruled out for this reason. A tree or heirarchical organization is not possible with the differing points of view of data base access required by the INCA participants. Any one data viewpoint can be used to create a tree structure for the TASDB, but would result in a highly inefficient usage for another participant's viewpoint. Typical opposing viewpoints would be considering communication paths to be the root of the tree and branching downward with circuits, trunks, links, etc., as shown in Figure 6-1. Another user might need to consider end-end circuits as the root of a tree and differently set up the downward branching of the remaining data. A plex or network structure permits all the data to be interrelated efficiently for any viewpoint. As a consequence, no tree structure exists with the physical organization of the data, but a highly inter linked set of data files. Any user might enter the network (without requirement for any concern for how the network is set up) and his usage might be traced as either a tree or network laid out on the physical network of inter-related data files.

6.3 TASDB CAPABILITIES

This subsection describes the various access techniques to the data held in the TASDB and information access capabilities of the TASDB. In general, a user may enter the data base at any of the major data categories described above and view the remaining data as being heirarchically oriented below that level. The subsequent

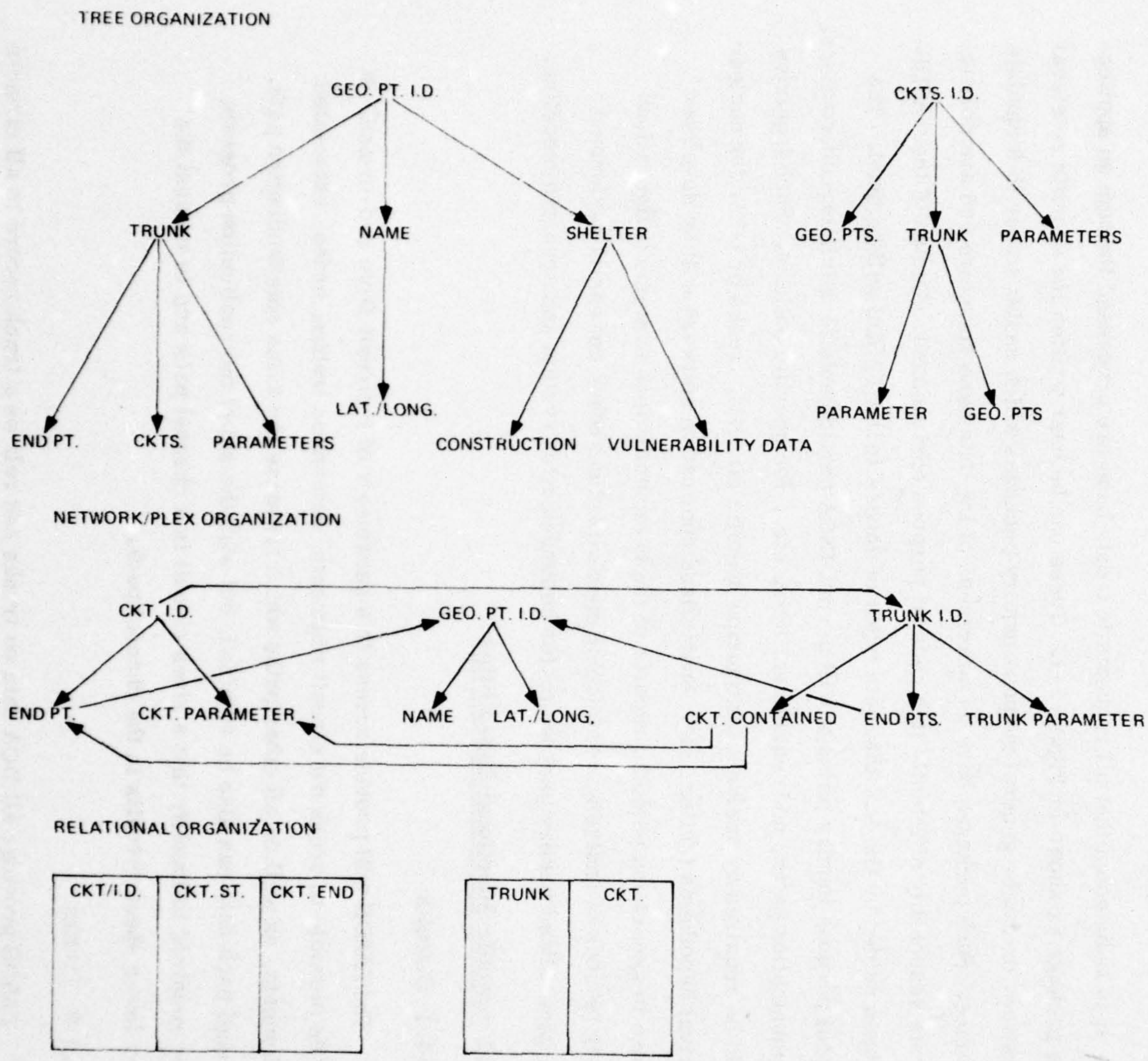


Figure 6-1. Types of Data Base Systems

subsections describe the various major data categories in turn and their access to the sub-oriented data.

It is to be noted that all requests to a data base are processed through an applications package as shown in Figure 5-1. These can be user written for specific retrieval operations or can be general purpose inquiry packages which assist a user to formulate inquiries. Such packages have an awareness of the data base structure and are able to operate reasonably efficiently in a general purpose environment. Design of the TASDB has been guided by the fact that both types of access to the TASDB will be used. The general purpose inquiry package will permit INCA participants to obtain circuit routings, communication paths, node equipment lists, etc., for specific entities. Such inquiries would be required by analysts configuring specific circuits, trunks or other for nuclear survival hypothesis testing, etc. Specialized application software will be developed for use in generating periodic reports of the communications system configurations during periods of analysis, performing specialized searches not easily performed by a generalized inquiry package or for communication system and scenario modeling.

6.3.1 Specific Functional Capabilities

6.3.1.1 Circuits

The TASDB will provide access to a parameter of a circuit from end-to-end. It will be possible to break out circuit segments, determine trunks, nodes, associated equipments, as well as all other paths which traverse the same communication path. Channel pack data can also be obtained, but with the aid of the application program being required to identify that a given circuit is a channel pack and to request the other lower speed circuits in the channel pack.

6.3.1.2 Trunks

TASDB provides all DCA data on trunks and relates a trunk record to all circuits of its circuit file as well as the transmission links used. Through cross references in the TASDB, nodes, equipments networks related to the trunk can be identified.

6.3.1.3 Links

Given a link identifier, all trunks, circuits nodes, associated equipments related to to the link can be retrieved. Networks, communications paths and number of circuits dependent on the links can also be identified.

6.3.1.4 Networks

Using the appropriate identifier for any network (e.g., AUTODIN, CRITICOMM, etc.) it is possible to identify all circuits, communications paths, trunks, links, nodes and equipments involved with the given network.

6.3.1.5 End-to-End

Given any pair of end-to-end geographic points or users (providing such data is supplied for data base initialization), it is possible to identify all circuits, trunks, links, communications paths, equipment and network associated with the specified end-to-end pair of geographic locations.

6.3.1.6 Communications Path

The communications path file describes every path (circuit flow) taken by a circuit. Shown are equipments, facilities, nodes, trunks, links, cables, etc. If more than one circuit takes the same path, then the path is maintained exactly once in the communications path file. Using the communications path file, it is possible to identify all components of the path as well as descriptions of the equipment, numbers of and identification of circuits using the path, the networks involved and the end-to-end users or locations for the path.

6.3.1.7 Sites

Given a specified site or sites, references can be made to equipments at the site (type, manufacturer, description) trunks, circuits, links and communications paths passing through the site. Further information can be obtained by referencing the indicated circuits, trunks etc. to determine if these entities are not available, what networks, users or geographic pairs are not available for communications because of the results of a particular scenario.

6.3.1.8 Equipments

Using the DCA MERL number, military nomenclature or Federal Stock Number, inquiry can be made into the TASDB to determine where the specific equipment is located, what circuits, trunks, links utilize it and what networks, end-end users or geographic points are supported by that equipment.

6.4 REFINED INQUIRY PROCESSING

There will undoubtedly be inquiries more complex than those cited above. For example, instead of requesting one or more specified circuits, only a count of the number of circuits qualifying to some parameter value may be desired. A request might be required which lists circuits by restoration priority, etc. The TASDB can not be organized to satisfy directly every request conceivable. Rather it is structured to relate entities one to another. Some requests can be directly satisfied: obtain all parameters of circuit x. Others may require retrieving all circuits and examining their record content to see if some parameter value is present and then list those. Such inquiries might be termed indirect inquiries or refined inquiry processing.

Applications programs are required to provide user interface to the DBMS for direct requests. In the case of indirect (or refined processing) inquiries, the application program must also provide the additional logic to process a set of direct requests which provide the application program with the data necessary to perform the refined processing in satisfaction of the original inquiry. Reference manuals for the DBMS used in the TASDB will describe how this is done in detail for each of the major programming languages (COBOL, FORTRAN etc.).

SECTION 7 - TECHNICAL ANALYSIS SUPPORT DATA BASE (TASDB) - DETAIL DESIGN SPECIFICATION

In this section, the detail design of the Technical Analysis Support Data Base is specified. Depth of the design specification is carried to the level of file definitions, file record formats, inter-file pointers for chaining records of one file to related records of another file and file volume estimates. Volume estimates are considered to be guideline values and must be determined during the implementation phase when the most current volume data is available.

7.1 DATA BASE MANAGEMENT SYSTEM

TOTAL (manufactured by Cincom Systems, Inc., Cincinnati, Ohio) has been selected as the data base management system under which the TASDB is developed. Operation shall be 6-mode (as it is termed by Cincom Systems, Inc.) which permits cross-region intercommunication with only one copy of TOTAL resident to serve multiple simultaneous batch or real-time applications. Core requirements are tentatively estimated at:

• TOTAL nucleus code	14K bytes
• Buffer I/O area	30K bytes
• File control area	9K bytes
	53K bytes

Buffer I/O area is estimated as 6K bytes per buffer per file active in any one inquiry. At this time, there appear to be five files active simultaneously for the worst-case inquiry. File control area requires 500 bytes per file in the TASDB. There are eighteen files in the TASDB architecture.

Cincom Systems, Inc., utility software which should be procured with TOTAL include:

- Back-up Utility - to checkpoint the entire data base as of a certain date. Backup and recovery are areas of major concern in an installation operating under a data base management system. The CINCOM recovery utility ensures restoral of "before" images.

- Hi-Speed Unload-Load Utility - permits one or more files of the data base to be copied to another storage device, reformatted as required, and then reloaded. This function is useful when changing the record format of a file by data element addition, deletion or re-arrangment, etc. The remainder of the data base need not be disturbed. No chains of pointers are lost in this process and after reloading the file, the pointers of all files to this file and reverse are in proper order.

- Print, Modify/Statistics - This utility performs two functions: (1) the data base administrator (DBA) can inspect any data element or record in the data base and modify it is necessary, (2) the DBA can obtain data base and component file utilization statistics which permit the DBA to five times the operating efficiency of the system.

- SOCRATES - a report generated which can be easily and readily used by programmers and non-programmer personnel to quickly obtain reports from the Data Base. It is a batch mode package.

7.2 TASDB COMPUTER HARDWARE

Current planning for the TASDB requires that it be operational on a DEC PDP-11/70 computer system since specification envisions implementation of the TASDB on a PDP-11/70 at Computer Sciences Corporation, Falls Church, Virginia. (Note - TOTAL and application programs are transportable to IBM, Honeywell, CDC computers and several other minicomputers. DEC equipment is not a specific TOTAL requirement). Primary storage devices for the data base files will be on DEC RP04 disk storage units having an approximate storage capacity of 88 million bytes each.

The TASDB design is not sensitive to these equipments and other units such as a different computer or disk storage units may be utilized. The only requirement is that sufficient disk storage be on-line to hold the entire TASDB when it is to be used and that additional disk storage or a tape drive be available to log TASDB updates which are required for reconstruction of the TASDB in the event that a previous checkpoint copy to the TASDB must be used.

7.3 TASDB DATA FILES

Under TOTAL, there are two kinds of files: Master files, which are entered using a keyword to retrieve a unique item (e.g., a circuit record) and variable files which contain further descriptive data or data related to more than one master file (e.g., a cross-reference file which links two distinct master files together such as a circuits master file and eight variable files (seven if one is merged with a master file) in the TASDB. Figure 7-1 presents the TASDB system block diagram. Squares represent master files and hexagons represent variable files. It can be easily seen that master files depend on variable files for such functions as:

- Cross-reference to other master files in a manner similiar to the DCS communications structure (e.g., circuits, trunks and links have definite relationships to each other)
- Sharing of common information (the MERL equipment number, A/N nomenclature and Federal Stock Number). Since master files relate all common items, information such as description and manufacturer can be shared.

In the file description below, the file name for programming purposes is given and follows DCA Hybrid Simulation Facility file name conventions. Four characters are used: first is R to indicate a file at Reston; second is M or V to indicate a TOTAL master file or variable file; the two remaining characters are alphanumeric and are available to the system design tc name the file uniquely.

7.3.1 Master Files

Eleven master files are specified in this subsection. Master files are the entry points to the TASDB. All inquiries must start at a selected master file and can then access other variable and master file records to link/point to related records in variable files. These files in turn can point to other master files.

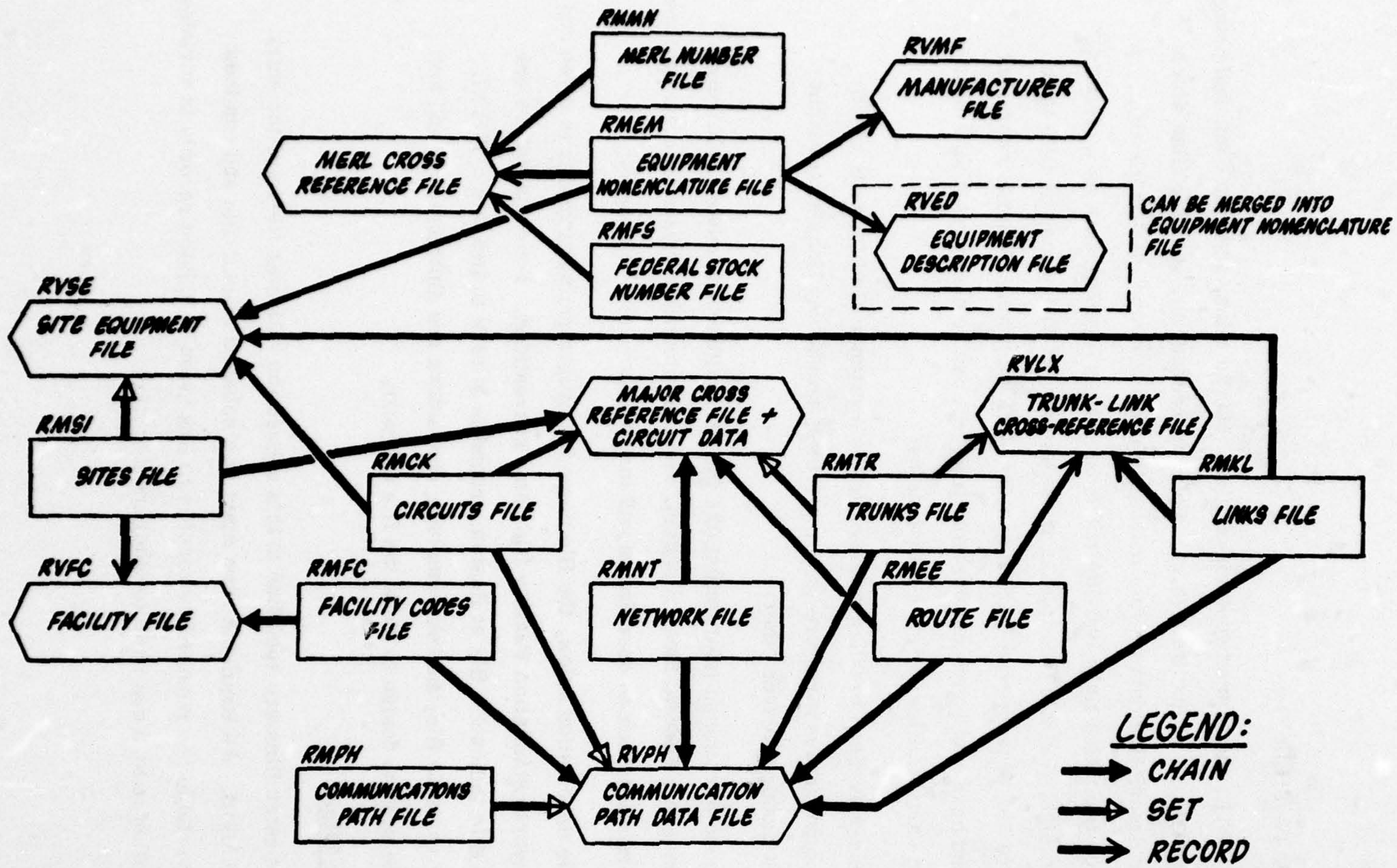


Figure 7-1. INCA Technical Analysis Support Data Base Architecture

7.3.1.1 Circuits Master File

Descriptive File Name - CIRCUITS

System File Name - RMCK

Pointers to Variable Files:

- Communication Path Detail File (RVPH)
- Site Equipment File (RVSE)
- Circuit Detail, Trunk, Network, End-to-End Cross-Reference File (RVXX)

Access Key - CCSD Identifier

Purpose - Contains access key (circuit identifier), pointers to related variable files described above and ten spare bytes for Automated Assessment Tool usage during scenario analysis.

User enters this file to request a specific CCSD and as required, records from the related variable files.

Proposed File Content:

Data Element	Bytes	
DCA CCSD for Circuit	8	File Key
Pointer to major cross reference RVXX	8	
Pointer to site equipment file RVSE - Site 1	8	
Pointer to communication path detail RVPH	8	
Pointer to site equipment file RVSE - Site 2	8	
Spare bytes (for AAT use)	10	

7.3.1.2 Trunks Master File

Descriptive File Name - TRUNKS

System File Name - RMTR

Pointer to Variable Files:

- Circuit Detail, Trunk, Network, End-to-End Cross-Reference File (RVXX)
- Trunk, Link, End-to-End Cross Reference File (RVLX)
- Communications Path File (RVPH)
- Site Equipment File (RVSE)

Access Key - Trunk Identifier

Purpose - Contains trunks data for each trunk of DCS and permits access to records of related links in given trunk, equipment at the sites terminating the trunk and related circuits within the trunk. It is possible to obtain trunk fill by following point chain in the circuit detail, trunk, network, end-end cross-reference file (RVXX). All links composing the trunk are obtained by following a pointer chain in the trunk, link, end-end cross-reference file (RVLX). Each record in that chain contains a link identifier and pointer to the link record in the Links Master File (RMLN). Using the pointer chain to the records in the communication Path Detail File (RVPH), all communication paths related to a given trunk can be found. Ten spare bytes are provided for use by an Automated Assessment Tool.

Proposed File Content Data Element	Bytes	
Trunk identifier	6	file key
Pointer to Major Cross-Reference RVXX	8	
Pointer to Trunk-Link Cross-Reference RVLX	8	
Pointer to Comm. Path Detail RVPH	8	
Direction indicator	1	
Terminal frame location	8	
Facility code (from)	3	
State/Country (from)	2	
Terminal to location	8	
Facility code (to)	3	
State/Country (to)	2	
Service availability	1	
Restoration Category	1	
Package System Cross-Reference (CCSD)	8	
Trunk Capacity	4	

Proposed File Content Data Element (Cont'd)	Bytes
Bandwidth	5
From Trunk Terminal Equipment	3
To Trunk Terminal Equipment	3
Commercial Radio Group Cross Reference ID	5
Space Bytes (for AAT usage)	10

7.3.1.3 Links Master File

Descriptive File Name - LINKS

System File Name - RMLN

Related Variable Files:

- Trunk, Link, End-to-End Cross Reference File (RVLX)
- Communications Path Detail File (RVPH)
- Site Equipment File (RVSE)

Access Key - DCA Link Identifier

Purpose - Contains DCA link parameters primarily for each link in the DCS. Retrieval of a record from this file gives link data plus pointers to related termination sites, equipments, trunks supported and communications paths supported. Ten spare bytes are provided for use by the Automated Assessment Tool.

Proposed File Content:

Data Element	Bytes
DCA Link Identifier	5
Pointer to site equipment file RVSE-Site 1	8
Pointer to site equipment file RVSE-Site 2	8
Pointer to trunk-link cross reference	8
Pointer to communication detail cross reference	8
Trailer Terminal Location	8

Data Element (Cont'd)	Bytes
Facility Code	3
State/Country	2
DCA Area Code	1
Link Control Office	1
Master Group Number	1
Super Group Number	1
Group Number	1
Trunk Transit or Terminal	1
Transmission Medium	3
Trunk Cross-Reference	6
Space Bytes (for AAT usage)	10

7.3.1.4 Network Master File

Descriptive File Name - Networks File

System File Name - RMNT

Related Variable Files:

- Major Cross-Reference File (RVXX)
- Communication Path Detail File (RVPH)

Access Key - Two letter network identifier characters 2-3 of a circuit CCSD)

Purpose - Contains network identifier and pointers to the related variable files in order to permit quick and efficient access to the subset of circuits, sites, equipments, and communication path detail. Trunks, links, etc., which are related are found by using pointers to other master files from the related variable files cited above.

Proposed File Content:

Data Element	Bytes	
Network Identifier (characters 2-3 of CCSD)	2	file key
Pointer to Major Cross Reference File RVXX	8	
Pointer to Comm. Path Detail File RVPH	8	
Network Name	10	

7.3.1.5 Site Master File

Descriptive File Name - Site File

System File Name - RMSI

Related Variable Files:

- Facilities File (RVSF)
- Site Equipment File (RVSE)
- Major Cross Reference File (RVXX)

Access Key - DCA Abbreviated Site Name

Purpose - Contains data relevant to the specific site as well as pointers to the Facilities File (RVSF) which chains all facilities (e.g., MDF, TCF, etc.) found at that site and to the Site Equipment File (RVSE) which contains sets of detail records, one per each piece of equipment at the given site. Using the link to the Major Cross Reference File (RVXX), all circuits, trunks, networks and communication paths supported can be located. Links dependent on that site are located through the Trunks File (RMTR).

Proposed File Content:

Data Element	Bytes	
Site name	8	file key
Pointer to site equipment file RVSE	8	
Pointer to facility file RVSF	8	
Pointer to Major Cross Reference File RVXX	8	
Full Spelling of Site Name	25	
Latitude	7	
Longitude	8	

Data Element (Cont'd)	Bytes
DCA Area Code	1
DCA Country Code	2
DCA State Code	2
Facility Description	20
Vulnerability Data	
Blast	4
EMP	4
Radiation	4
Thermal	4
Fallout	4
Sabotage	4
Restoral	4
ECEMP	4
SCEMP	4
TREE	4
Space Bytes (for AAT usage)	10

7.3.1.6 Facilities Code File

Descriptive File Name - Facilities Code File

System File Name - RMFC

Related Variable File (RVSF)

- Facilities File (RVSF)
- Communication Path Detail File (RVPH)

Access Key - DCA Facility Code

Purpose - This file contains a DCA facility code abbreviation and pointers to two variable files. The pointer to the Facility File (RVSF) will chain together all sites using the facility class for rapid identification of such sites while the pointer to the Communication Path Detail File (RVPH) will chain together all all paths using the given facility (and through reference via other files, related circuits, trunks and links can be found).

Proposed File Content:

Data Element	Bytes
DCA Facility Code	3 file key
Pointer to Facility File RVSF	8
Pointer to Communication Detail Path File RVPH	8

7.3.1.7 Communications Paths Master File

Descriptive File Name - Communications Paths File

System File Name - RMPH

Related Variable Files:

- Communications Paths File (RVPH)

Access Key - CSC defined path nomenclature

Purpose - Using the path identifier, the set of path detail records in the variable file (RVPH) which describe the path can be located. Extended reference through pointers from the variable file.

Proposed File Content:

Data Element	Bytes
Path Identifier	4 file key
Additional Path Identifier	3
Pointer to Communication Path Detail File	8
Space Bytes (for AAT usage)	10

7.3.1.8 End-to-End Master File

Descriptive File Name - End-to-End Index File

System File Name - RMEE

Related Variable Files:

- Major Cross-Reference File (RVXX)
- Trunk-Link Cross Reference File (RVLX)
- Communication Path Detail File (RVPH)

Access Key - Concatenated pair of geographic points or end user identification. DCA nomenclature is used for each member of the pair and the lowest alphanumeric element is used as the first member of the pair.

Purpose - This file is an index entry to permit a user to use two geographic points (or end users) to access/retrieve all circuits, trunks, links, communications paths, etc., as may have been requested by the inquiry. Use of this index file as an entry to the TASDM merely provides a more efficient method of retrieval for a frequently expected inquiry of this type. With more burden on the application program, length searches could have produced the same information without using disk space for this file.

This file is a good example of providing a master file, the only purpose of which is to intercept a frequent usage/inquiry type and make desired records more readily available. As the TASDB usage grows, there may be justification to establish more such master files.

Proposed File Content:

Data Element	Bytes	
2-triple of geographic/user points	16	file key
Pointer to Major Cross Reference File RVXX	8	
Pointer to Trunk-Link Cross Reference File RVLX	8	
Pointer to Comm. Path Detail File RVPH	8	

7.3.1.9 MERL Number Master File

Descriptive File Name - MERL number file

System File Name - RMMR

Related Variable Files:

- MERL Cross Reference File (RVMX)

Access Key - DCA MERL number of specified piece of equipment

Purpose - An index Master file for entry using the MERL number to equipment description (standard DCA MERL file) and to be able to access sites at which that equipment can be found. The latter is accessed through use of the MERL cross-freference file to obtain the DCA standard nomenclature and then access can be made to the two variable files containing MERL file information (RVMM and RVMD) and to the site equipment variable file (RVSE)

Proposed File Content:

Data Element	Bytes	
DCA MERL number	6	file key
Pointer to MERL cross-reference file RVMX	8	

7.3.1.10 Federal Stock Number Master File

Descriptive File Name - FSN File

System File Name - RMFS

Related Variable Files:

- MERL Cross-Reference File (RVMX)

Access Key - Federal stock number of the specified equipment

Purpose - Same as given for the MERL number master file except that the federal stock number is used as the entry access key.

Proposed File Content:

Data Element	Bytes	
Federal Stock Number	11	file key
Pointer to MERL Cross Reference File	8	

7.3.1.11 Equipment Nomenclature Master File

Descriptive File Name - Equipment Nomenclature File

System File Name - RMEN

Related Variable Files:

- MERL Cross-Reference File (RVMX)
- Manufacturer File (RVMF)
- Site Equipment File (RVSE)

Access Key - Standard DCA equipment nomenclature

Purpose - Using the nomenclature (given or derived from given MERL number or Federal stock number), access can be made to files to obtain MERL number, federal stock number, equipment description, manufacturer and sites at which the equipment is located. This file contains the narrative description of the equipment as well as the nomenclature key.

Proposed File Content:

Data Element	Bytes
DCA nomenclature	20
Pointer to MERL cross-reference RVMX	8
Pointer to manufacture file RVMF	8
Pointer to MERL descriptive data RVED	8
Equipment description	30
Vulnerability Data	40

7.3.2 TASDB Variables Files

Variable files hold information common to one or more master files as well as providing a means to cross-reference two or more master files. Seven variable files are used in the TASDB architecture.

7.3.2.1 Major Cross-Reference Variable File

Descriptive File Name - Major Cross Reference File

System File Name - RVXX

Purpose - This file contains DCA circuit parameters for each circuit and has pointers for cross-reference to site equipment, sites terminating the circuit, trunks, the network circuit is part of and the end-to-end user/geographic points.

Proposed File Content:

Data Element	Bytes
Header Record From Location	8
State/Country Code	2
DCA Area Code	1
Facility Code	3
Modulation Rate	2
Type of Operation	1
Service Availability	1
Restoration Priority	2
Restoration Priority Cert.	1
Security Equipment - Disection 1	2
Security Equipment - Disection 2	2
Trunk Cross Reference	6
Segment Record	
Terminal Location	8
State/Country Code	2
DCA Area Code	1
Facility Code	3
Transmission Pathway	6
Channel Number	3
Type of Channel	1

	Bytes
Multipoint Flag	1
Service Availability	1
Circuit Control Office	1
Equalizer Location	1
Echo Suppressor Location	1
Regen Repeater Location	1
Type of Signaling	1
Type of Segment	1

Records to include appropriate pointer chain fields.

7.3.2.2 Communications Path Detail Variable File

Descriptive File Name - Communication Path Detail File

System File Name - RVPH

Purpose - There are two record types in this file. Type one is a header record with end-to-end communication path data (TOTAL record code HD) and type two records which are a set of detail records describing each segment of the path (circuit). The latter are identified by TOTAL record code DT. Using this file, cross reference can be made to further detail in the circuits file (RMCK), network file (RMNT), end-to-end user/geographic point file (RMEE), links file (RMLN) and the facility code file (RMFC).

Proposed File Content:

Date Element	Bytes
Path Header Record	
Path Identifier	12
Associated Network	8
From Location	17
To Location	17

Data Element	Bytes
Type of Service	
Spare Bytes (for AAT usage)	10
Link Record	
Link Identifier	5
Spare Bytes (for AAT usage)	10

Records to include appropriate pointer chain fields.

7.3.2.3 Facility Variable File

Descriptive File Name - Facility file

System File Name - RVSF

Purpose - This file contains the descriptive information on the facility type and contains a chain to point to all sites at which that facility type is used.

Proposed File Content:

Data Element	Bytes
Facility Description	55
Site Plan Number	15
Site Plan Number Location	15
Spare Bytes (for AAT usage)	10

Record to include appropriate pointer chain fields.

7.3.2.4 Trunk-Link Cross-Reference Variable File

Descriptive File Name - Trunk Link Cross-Reference File

System File Name - RVLX

Purpose - This file is intended only to cross-reference trunks, links and terminating geographic sites which are contained in Master files.

Proposed File Content:

This file contains only pointer fields between the following master files: RMTR, RMLN and RMEE.

7.3.2.5 Site Equipment Variable File

Descriptive File Name - Site Equipment File

System File Name - RVSE

Purpose - This file contains sets of detail records, one set per site. Each detail record identifies and describes an equipment at the given site. The set header record contains limited information about the site and full site detail information is contained in the Site Master File (RMSI). Header records have a TOTAL record code of HD, and detail records have a record code of DT. Site equipment can be retrieved as a set given a site and pointer from the Site Master File (RMSI). A chain of a specific equipment type for all sites pointer to by a pointer from the equipment nomenclature file (RMEM) is included. This permits rapid retrieval of all sites where a specified equipment is found.

Ten spare bytes are kept in each detail record for use by the automated assessment tool in deleting or degrading equipment during scenario processing.

Proposed File Content:

Data Element	Bytes
Equipment nomenclature (abbr)	12
Use Code R = receive	1
S = send	
P = power	
etc.	
Spare bytes (for AAT usage)	10

Record to include appropriate pointer chain fields.

7.3.2.6 MERL Cross-Reference Variable File

Descriptive File Name - MERL Cross-Reference File

System File Name - RVMX

Purpose - Equipment nomenclature is used to access equipment at sites (files), manufacture files, and the equipment description file. If the MERL number or federal stock number is used, then this must be translated via this MERL Cross-Reference File to the corresponding nomenclature in order to access the same data, but using one of the other two identifications as an inquiry access method.

Proposed File Content:

Since this is a cross-reference file, only pointer chain fields are to be included.

7.3.2.7 Equipment Manufacturer Variable File

Descriptive File Name - Manufacturer File

System File Name - RVMF

Purpose - This file contains data concerning the manufacturer of one or more equipments. While it could have been maintained in the equipment nomenclature records, there exists the possibility of several manufacturers for the same piece of equipment. Therefore, there could not be unique records in that Master file. Consequently, a variable file is used to contain these possible sets of alternative manufacturer records and all other single records as well.

Proposed File Content:

Data Element	Bytes
Manufacturer code (MERL)	5
Manufacturer name and address	80

Record to include appropriate pointer chain fields.

SECTION 8 - PROTOTYPE INCA TECHNICAL ANALYSIS SUPPORT DATA BASE

To demonstrate the concepts and detailed design of the INCA Data Base System, a prototype (but operationally useful) data base describing trans-Atlantic communications has been created by CSC using the TOTAL data base management system on an IBM-370/155 at DCA-Reston (DCEC). The data base was designed as a straightforward model of the communications networks. In accordance with DCA data base naming conventions, it is called RFBTAC (Reston, batch mode, Trans-Atlantic Communications). RFBTAC exists only on the classified data system; currently an unclassified copy is being created for general development work. Figure 8-1 is a general system level block diagram of the data base.

8.1 MASTER DATA FILES

Four master files were created to reflect the four major components of the communications system (single circuit and networks):

- Trunks
- Links
- Circuits
- Sites (terminal points for trunks, links, and circuits)

Each record in a master data file reflects a single trunk, circuit, link or site. Tables A-1 through A-6 in Appendix A describe the format of each record type, as well as showing TOTAL system control links (chains of pointers). File names were selected using the DCA file name conventions; for example, RMTR is the trunk file name (Reston, Master-file, user ID such as trunks, in this case). Circuit file uses the name RMCT; link file, RMLK and RMSI, site data file.

8.1.1 RMTR - Trunk Data File

The records of RMTR each describe an individual trunk in the communication system. Records are keyed on trunk identification code, as given by standard DCA nomenclature, with the additional specification of service availability. This allows programmed

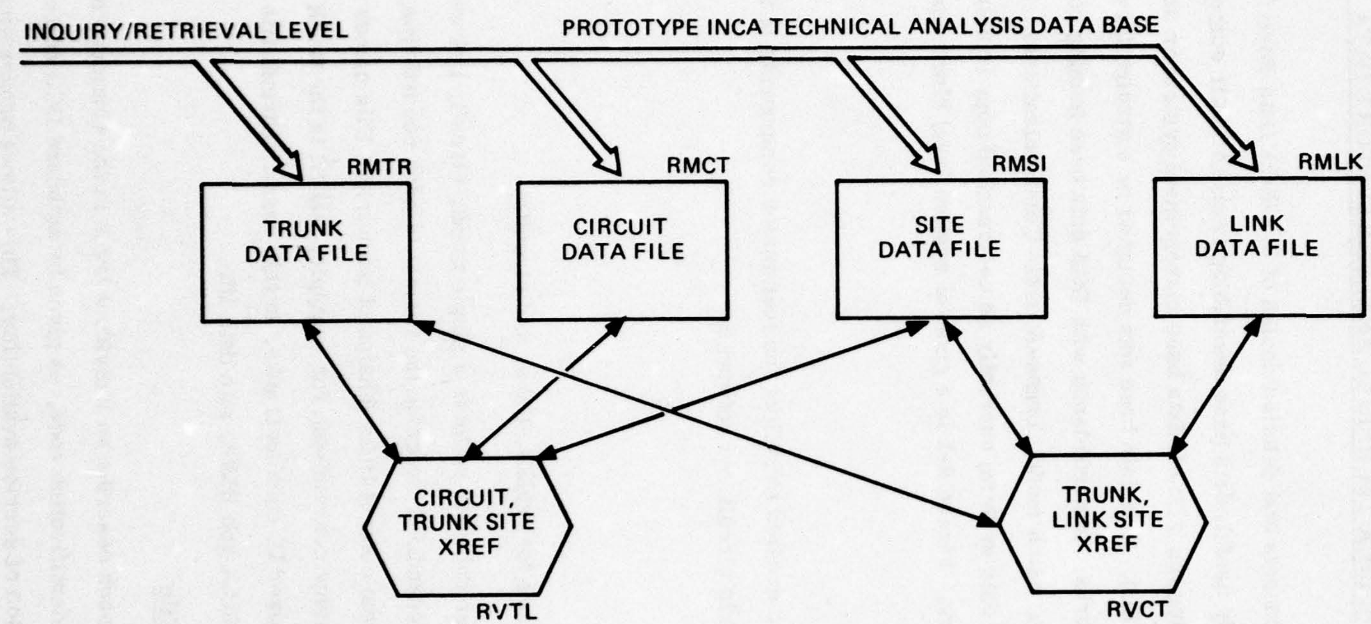


Figure 8-1. Prototype INCA Technical Analysis Data Base

reroutes to be listed separately. All necessary linkages to logically relate this file to both variable entry files (RVCT and RVTL) are contained in these records. Through the variable files (used as cross-reference devices), trunk related circuit, link and site information can be rapidly retrieved from the corresponding master data files.

Information in a trunk record contains the following data:

- Record key (trunk identifier and service availability)
- Trunk operational status flag
- Restoration priority
- Trunk origination site
- Trunk termination site
- Number of channels in trunk
- Bandwidth
- Number of channels available
- Facility type at which trunk originates
- Facility type at which trunk terminates

8.1.2 RMCT - Circuit Data File

Each record of RMCT summarizes information about a circuit which is contained in the trans-Atlantic communications networks. Records are keyed by the Command Communications Service Designator (CCSD) assigned by DCA with an additional specification of service availability. This allows programmed reroutes to be distinctly identified in retrievals. All necessary linkages are contained to relate this data file to RVCT (a cross-reference device to access relate a circuit to its trunk and to site information). Data contained in each record consists of:

- CCSD and service availability
- Circuit operational status flag
- Restoration priority
- Point of origin
- Point of termination
- Type of circuit routing applied

- Pseudo trunk usage flag
- Pseudo trunk cross-reference
- Facility of origin
- Facility of termination

8.1.3 RMSI - Site Data File

Each facility at each site within the trans-Atlantic communications network is described by a record in RMSI. The location name, abbreviated according to the rules specified by DCA, with the facility code appended to it serves as the record key. This file contains the necessary linkages to associate sites with the appropriate records in both RVCT and RVTL, providing the cross-references to related circuit, trunk and link information. Information contained in each record consists of:

- Abbreviated location name and facility code
- State or country of location
- Site operational status flag
- Latitude/longitude of site

8.1.4 RMLK - Link Data File

The records of RMLK contain summary information on each link in the network. They are keyed by the DCA assigned link identification. Linkages to RVTL are provided affording access to related trunk and site information. Data contained in each record includes:

- Link identification code
- Link operational status flag
- Transmission media code
- First endpoint of link
- Second endpoint of link
- Type of facility at first endpoint
- Type of facility at second endpoint

8.2 VARIABLE ENTRY DATA FILES

Master data files are utilized to hold information concerning each of the four major elements of the trans-Atlantic communications system. Variable entry data files are used for three purposes generally:

- To store variable numbers of detailed records relating a single master record (in the case of an order entry system, the master file might contain invoice header information and the variable entry file might contain the detail records, one for each item ordered).
- To store detail information which relates to two different master records in two distinct master data files
- To serve only as a cross-reference device to go from one master data set to another master data set

In the prototype INCA Technical Analysis Support Data Base, the last objective of variable entry data files is used. Cross-referencing between the four master data files described above is then possible. Each of the two variable entry data files contains pointers to the records it cross references. It provides for such retrievals as: given the trunk master record, find all circuits which fill the trunk (trunk fill request). The two variable entry data files are:

- RVCT which cross-references the circuit, trunk and site master data files
- RVTL which cross-references the trunk, site and link master files

Information content is not listed for these files as they contain only DBMS pointers to records in the master data files where all information is kept. Appendix A gives the record formats of both variable entry files.

8.2.1 RVCT - Circuit, Trunk and Site Cross-Reference

The records in this file can be accessed from either RMCT, RMTR or RMSI. Each record lists a circuit and the trunk carrying it at the given site. For every circuit in the network, such a record is provided for each of its segments. In this way, all

the trunks employed by the circuit and all the sites it traverses are listed. Viewing these records from another perspective, other information becomes available. For example, at each site, all the circuits and trunk which pass through it are enumerated.

8.2.2 RVTL - Trunk, Link and Site Cross-Reference

The records in this file can be accessed from either RMTR, RMLK or RMSI. Each record represents a subsection of a trunk, listing the trunk identifier, the link carrying it, and the sites forming the endpoints. This allows easy access to information such as all the sites a trunk traverses and all the links it uses. Similarly, all the trunks carried by a link or all the links at a given site can be easily obtained.

8.3 DATA CODING

Much of the data in the data base follows standard DCA nomenclature for site names, trunks, parameters, etc. These are fully explained in DCA circular DCA 310-65-1. Appendix A contains a list of those codes/abbreviations, etc., which are used by the prototype INCA Technical Analysis Support Data Base. Record formats given in Appendix A indicate which data code table of the appendix applies.

SECTION 9 - FUNCTIONAL DESCRIPTION - RESOURCES DATA BASE (RDB)

This section sets forth the functional description of the Resources Data Base (RDB). Scope of the functional description include:

- Purpose and goals of the Resources Data Base
- Definition of the data base files
- Information accessing capabilities and limitations

The contents of these areas describe the functional requirements and capabilities of the RDB. Detailed design specifications follow in subsequent sections.

9.1 RDB PURPOSE AND GOALS

The Resources Data Base is the library information retrieval subsystem of the INCA Data Base System. It will catalogue reference information concerning the INCA program including codes, contractors, experts, etc. All INCA project reference data should be included.

The RDB will provide automated reference information to INCA personnel. By use of this data base, duplication of effort should be significantly reduced and as well, new INCA contractors can quickly locate materials which set a proper starting posture for their research and engineering efforts. The data base is designed to allow maximum flexibility within the confines of the DBMS. The user will have access to INCA reference information through various access routes. Included in the data base design are methods for file cross referencing. This permits maximum access with minimum of redundancy.

9.2 GENERAL DESCRIPTION

9.2.1 Content

Content of the RDB is limited to INCA reference data. Information will be maintained under the following categories:

- Key words
- Documents
- Codes
- Data bases
- Contracts
- Contractors/participants
- Experts
- Acronyms

Within each category will be a record for each individual entity. Such records will contain all pertinent reference information for that entity. Linkage between the categories will be provided in the records as dictated by the DBMS.

9.2.1.1 Keywords

Keywords facilitate RDB inquiries by linking all entities which relate to a given keyword (e.g., codes, documents etc.). A listing of nuclear phenomenology, nuclear effects, and communication systems descriptors and identifiers will aid the user in selecting appropriate keywords for a given inquiry.

9.2.1.2 Documents

Documents data will include data elements that describe documentation currently available, relating to INCA. This documentation can include code descriptions, users manuals, nuclear effects reports, et al. Typical data elements included are:

- Report title
- Report number
- Date issued
- Page count
- Security classification
- Government reference numbers - DDC # - i.e. AD XXXXX
- Distribution Restrictions
- Updates/revisions
- Author/Company
- Report Status - Draft, Final

9.2.1.3 Codes

Codes data will include all data elements describing computer codes. Typical data elements included are:

- Code name
- Mathematical models (foundation of Theory)
- Memory requirements
- Host computer
- Functional description
- I/O
- Documentation completeness
- Usage information (Prerequisites, Applications)
- Update revisions
- Responsible agency
- Documentation

9.2.1.4 Data Bases (Other than INCA)

Data Base data will include elements that describe current data bases or data sets. Typical data elements included in the data base category are:

- Data Base name
- Functional description
- Record info
- D. B. M. S.

9.2.1.5 Contracts

Contracts data will include elements that describe INCA contracts related to nuclear effects on communications. Typical data elements relevant to contracts include:

- Contract number
- Let date/completion date
- Responsible organization
- INCA WBS elements being worked

- Reports published
- Reports scheduled delivery dates

9.2.1.6 Contractors

Contractor data will include elements that describe INCA contractors. Typical data elements include:

- Contractor name
- Contractor address
- Contractor telephone number
- INCA affiliation
- Contractor program manager

9.2.1.7 Experts

Experts data will include data elements that reference personnel with nuclear assessment expertise. Such expertise shall encompass nuclear phenomonology, nuclear effects, related computer codes, et al, as deemed necessary by INCA. Typical data elements relating to experts include:

- Expert name
- Expert address
- Expert telephone number
- Associated company/contractor
- Area of expertise

9.2.1.8 Acronyms

Acronym data will include all acronyms or abbreviations relating to any subject included in this data base followed by the full expanded title corresponding to that acronym or abbreviation.

9.2.2 Data Base Organization

The organization of the RDB is contingent on the data accessing requirements of the user. RDB files need to be accessed through cross-reference to different files.

Consequently, RDB files must be able to interconnect with each other. Therefore, the logical structure of the data base requires a plex or network design as opposed to a hierarchical design. (Appendix B discusses types of data bases). Such a logical structure permits more efficient access and optimum interrelationships files. The data base files, however, are organized hierarchically. Their design is discussed in the detailed design specification section of this report.

9.3 RDB CAPABILITIES AND LIMITATIONS

This subsection describes the various data accessing techniques for the RDB including capabilities and limitations. The data base design criteria were produced as a result of the data base survey results and suggested user requirements. From this background, file accessing priorities were established that would create a comprehensive, efficient data base, but require a minimum of redundant information. Such a design permits maximum accessing capabilities, limited only in areas where direct record access need is minimal and information could be easily and readily available through other routes.

9.3.1 Specific Functional Capabilities

The RDB will access information via specific major categories - keywords, codes, contractors, and data bases. Other information can only be accessed through a reference to these files first.

9.3.1.1 Keywords

The RDB will provide access to information through use of keyword identifiers or descriptors. These keywords will link associated documents and experts directly. Other related information must be accessed via a cross reference catalogue.

9.3.1.2 Codes

RDB will provide access to reference information via code names. The code name will have direct access to associated documents, contracts, and experts. All other related information must be accessed via the cross reference catalogue.

9.3.1.3 Contractors

Contractor name is another access route to RDB information. Direct retrieval of experts to contracts is possible through this route. All other related information must be accessed via the cross reference catalogue.

9.3.1.4 Data Bases

Data base names is the final area that can access RDB reference information. It will directly access related documents or reports. Other related information must again be retrieved via the cross reference.

9.3.2 Specific Limitations

The RDB is organized such that some information cannot be directly accessed. This information however would normally be desired in conjunction with information that can be directly accessed.

Categories included in this limitation are:

- Documents
- Experts
- Contracts

For example, information about personnel could normally be related to codes associated with that person or contractors subsidizing the person or keywords that describe the area of expertise of the person. Experts information would not usually be accessed by itself. Therefore, to optimize the system, experts information must be accessed via other specified routes.

SECTION 10 - RESOURCES DATA BASE (RDB) - DETAIL DESIGN SPECIFICATION

This section specifies the detail design of the Resources Data Base. The Extent of this design will include file definitions, file content, file length and specifications, field lengths and specifications, inter-file pointers, and data base memory requirements. All volume estimates are considered to be guideline values. Final determination of volume must occur during the implementation phase.

10.1 DATA BASE MANAGEMENT SYSTEM

TOTAL (manufactured by Cincom System, Inc., Cincinnati, Ohio) has been selected as the data base management system (DBMS) under which RDB is developed. This permits incorporation of RDB with the TASDB under one DBMS.

Core requirements are tentatively estimated at:

• Total nucleus code	Specified under TASDB
• Buffer I/O area	24 K bytes
• File control area	4.5 K bytes

Buffer I/O area is estimated as 6K bytes per buffer per file active in any one inquiry. At this time, there appear to be four files active simultaneously for the worst case inquiry. File control area requires 500 bytes per file in the RDB. There are nine files in the RDB architecture. For further discussion of TOTAL, refer to Section 7.1 (Data Base Management System).

10.2 RDB COMPUTER HARDWARE

For RDB operational computer hardware specification, refer to Section 7.2 (TASDB Computer Hardware).

10.3 RDB DATA FILES

The TOTAL DBMS defines two kinds of data base files: Master files and Variable files. Master files required a single unique keyword to identify a record. Variable files have no keyword limitations, however they cannot be accessed as stand alone files. Variable files must be accessed via a master file.

Figure 10-1 presents the RDB system block diagram. Master files are represented by rectangles and variable files are represented by hexagons. As in the TASDB, variable files are necessary for sharing of common information and cross referencing of information between master files.

10.3.1 RDB Master Files

The RDB design specifies five master files. All inquiries must start at a selected master file which then can access other variable or master file. The following subsections define the detailed master file specifications for the RDB. The logical file structure is shown in Figures 10-2 through 10-5.

10.3.1.1 Codes Master File

Descriptive File Name - Code File

System File Name - RMCD

Related Variable Files:

- Documents File
- Experts File
- Contracts File
- I/O; Functional Description File
- Major Cross Reference File

Access Key - Code Name Acronym

Purpose: The Codes File contains information related to specific codes as well as pointers to: the Documents File which contains all documents and reports related to the code; the Experts File which contains all personnel familiar with the code; the Contracts File which lists contractual data of the code; the I/O - Functional Description File which contains inputs, outputs and functional description of the code; the Major Cross Reference File which links the code with Contractors, Data Bases and Keywords Files.

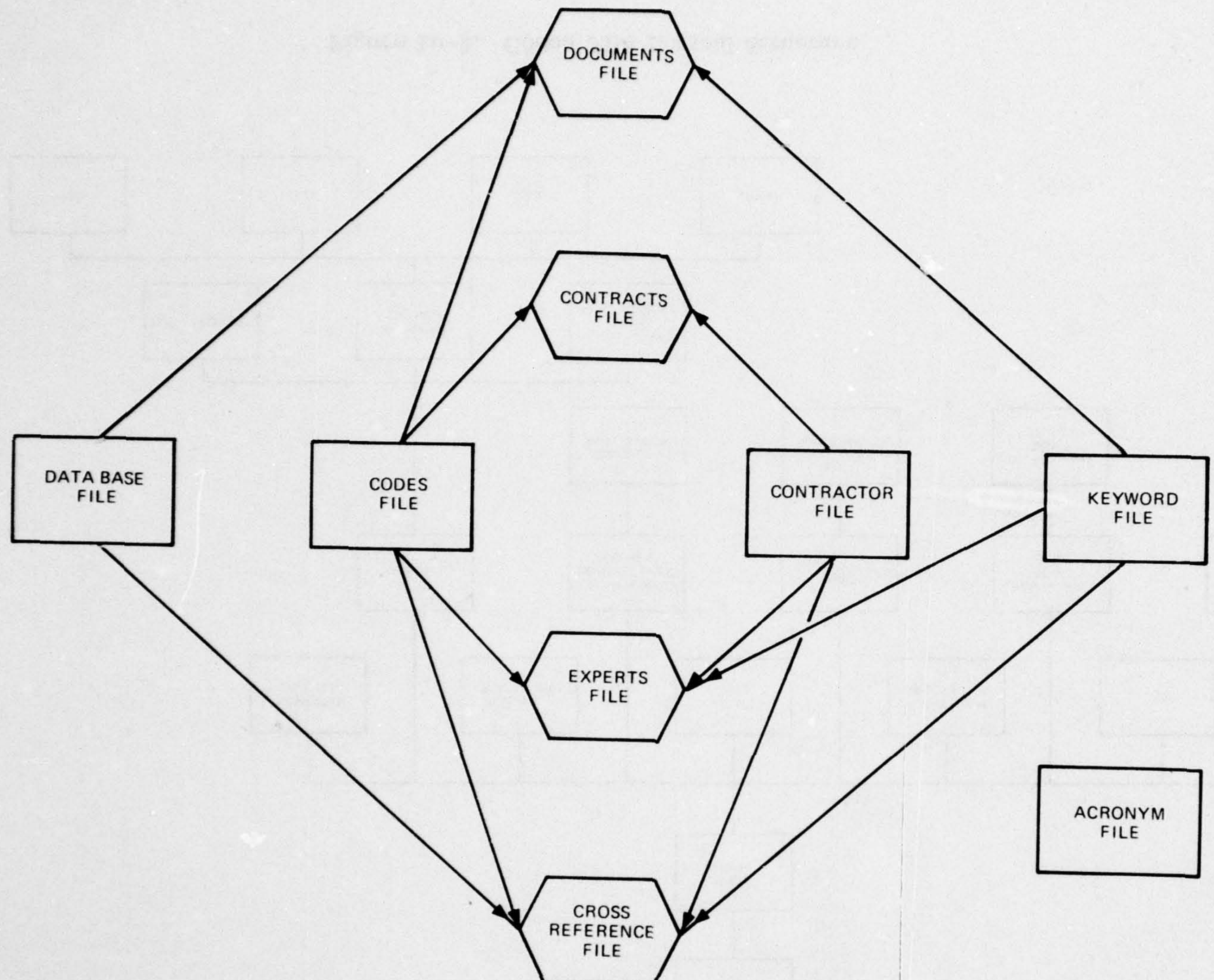


Figure 10-1. RDB File Relationships

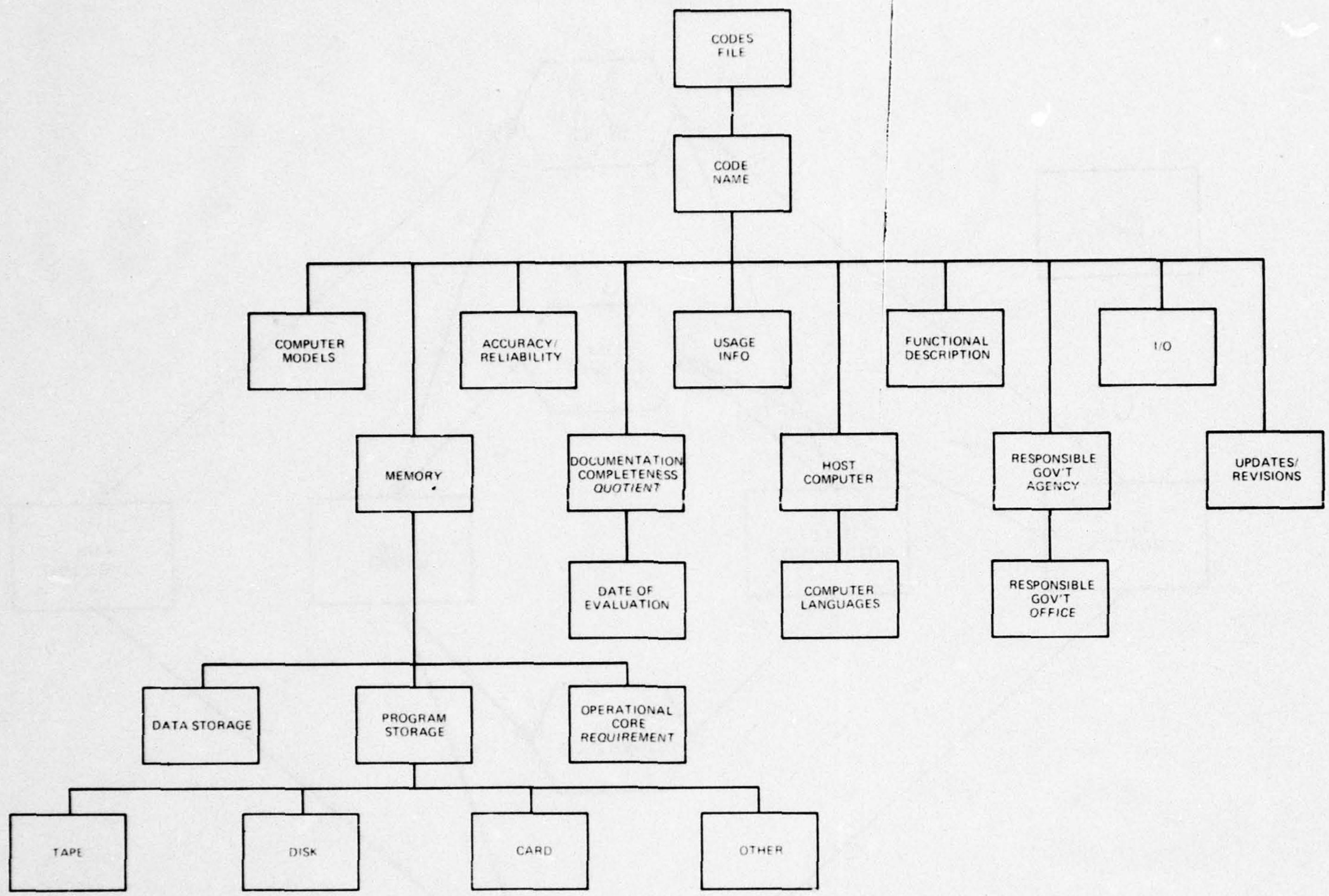


Figure 10-2. Codes File Logical Structure

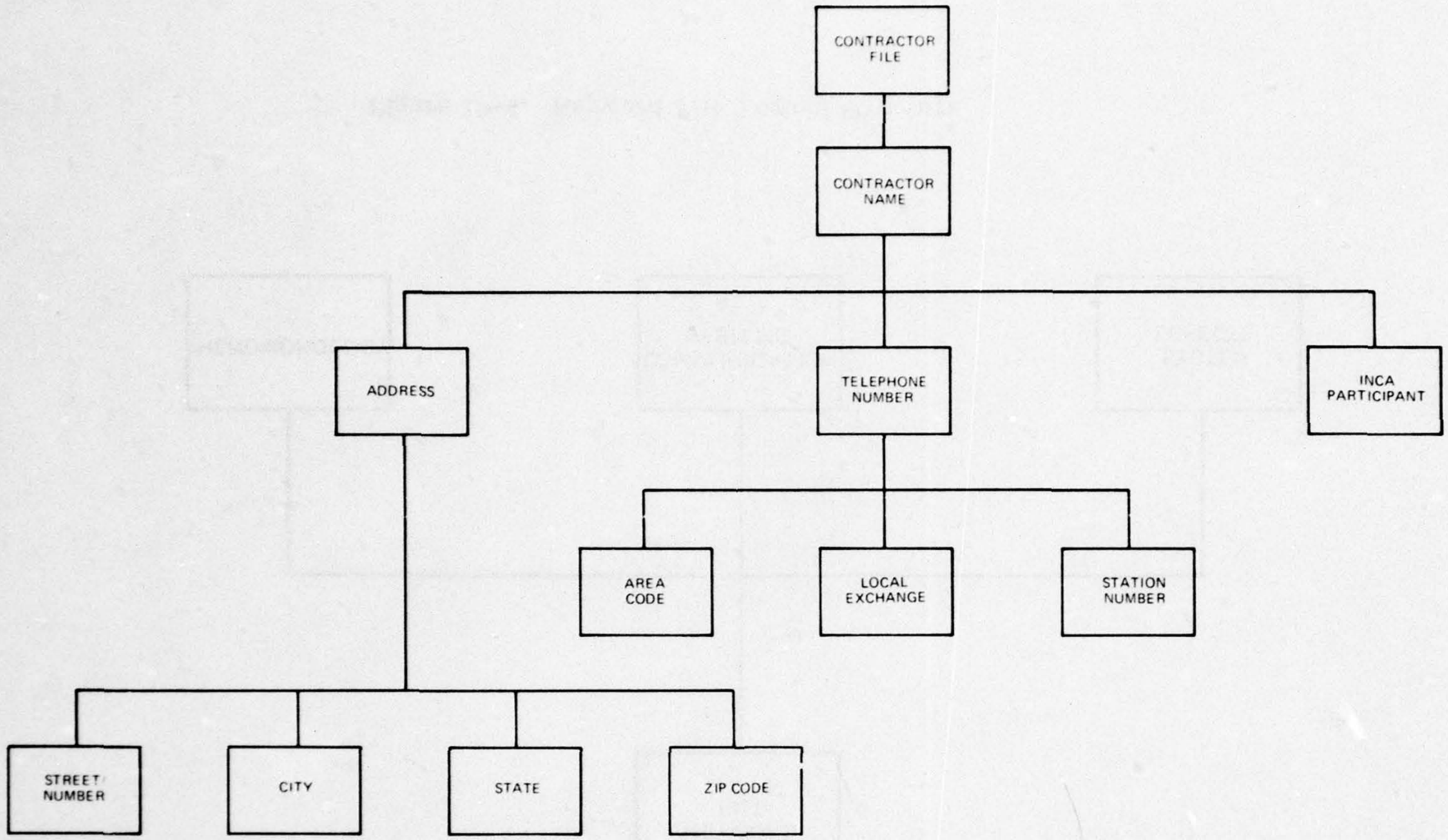


Figure 10-3. Contractor File Logical Structure

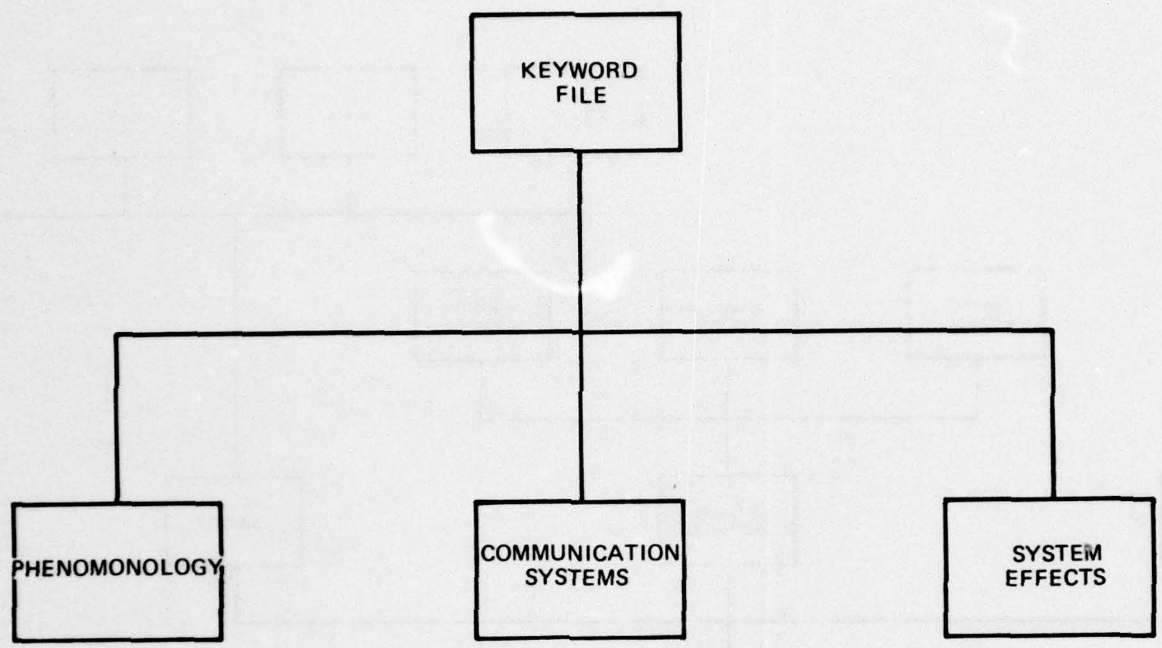


Figure 10-4. Keyword File Logical Structure

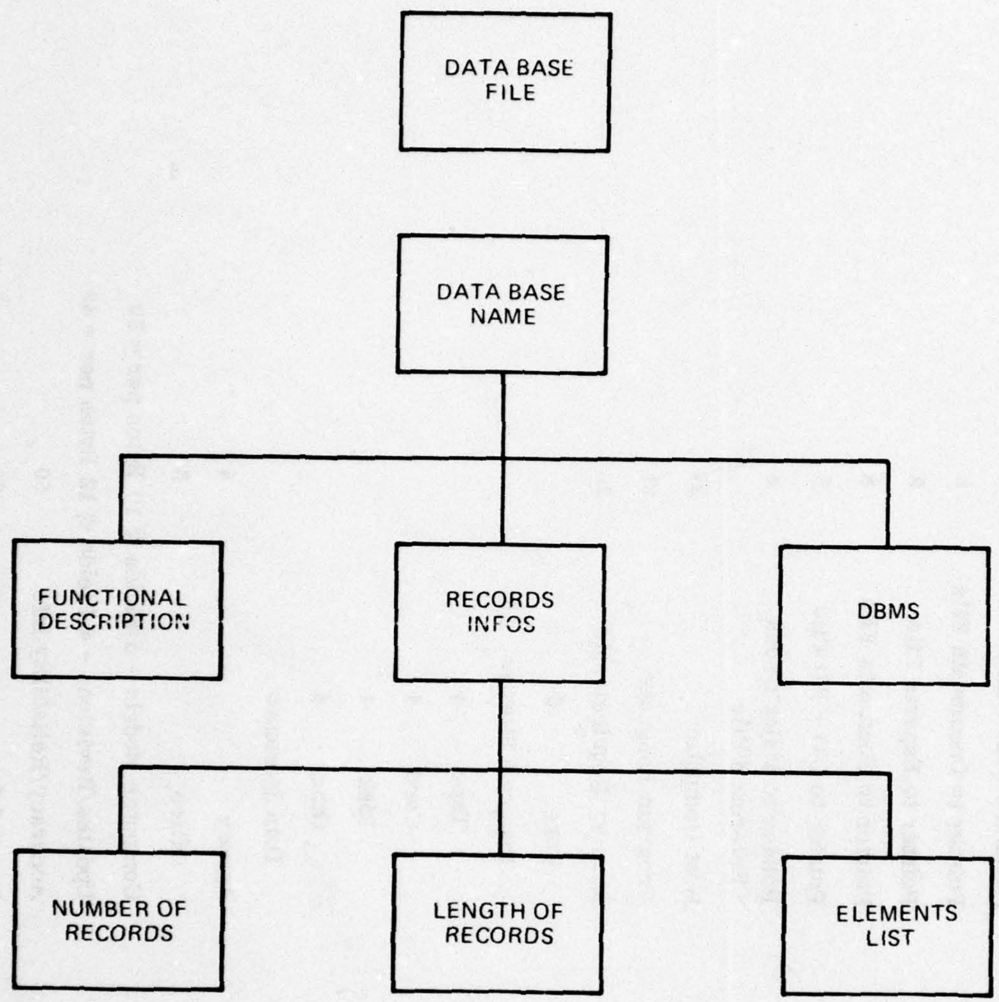


Figure 10-5. Data Base File Logical Structure

Proposed File Content:

Data Element		Bytes	
Code Name (Acronym)		8	File Key
Expanded Code Name		60	
Pointer to Documents File		8	
Pointer to Experts File		8	
Pointer to Contracts File		8	
Pointer to I/O - FD File		8	
Pointer to Major Cross Reference File		8	
Host Computer		27	
Program Language		21	
Memory Requirements		26	
Core	5		
Program Storage	16		
Tape	4		
Card	4		
Disk	4		
Other	4		
Data Storage	5		
Agency		4	
Office		6	
Computer Models - 5 Fields @ 10 Bytes per = 50			
Updates/Revisions - 4 Fields @ 12 Bytes per = 48			
Accuracy/Reliability Info		50	
Usage Info		30	
Documentation Completeness Quotient		2	
Date of Evaluation		13	
Input		300	
Output		250	
Functional Description		300	

Record Field Definition

Code Name - the code acronym (i.e., SIDAC)

Expanded Code Name - the full title of the code (i.e., Single Integrated Damage Analysis Capability)

Host Computers - a list of computer systems for which the code has been written or modified

Program Languages - the computer language utilized in the code

Memory requirements - the memory required to store and run the code and its results

Agency/Office - the responsible gov't agency and office (i.e., DCA/CCTC)

Computer Models - the mathematical models used for simulation (i.e., - windage; antenna ...)

Updates/Revisions - the dates of the four most recent revisions or updates of the code

Accuracy/Reliability Info - comment as to the accuracy and/or reliability of the code

Usage Info - comment as to the extent the code is used

Documentation Completeness Quotient and Date of Evaluation - number from 1 to 10 approximating the extent of code documentation plus the date of such evaluation.

Input - a list of required and optional inputs for a code

Output - list of standard and optional outputs for a code

Functional Description - abstract of the purpose and function of the code

10.3.1.2 Contractor Master File

Description File Name - Contractor File

System File Name - RMCT

Related Variable Files

- Documents File
- Experts File
- Contracts File
- Major Cross Reference File

Access Key - Abbreviated Contractor Name

Purpose: The Contractors File contain all relevant information regarding contractors or participants who are or have been involved in nuclear effects on communications. Pointers are included which link: documents and reports related to contractor; Experts File which chains all personnel with a contractor; Contracts File which chains contracts associated with a contractor; Keywords, data bases, and codes to the contractor via a Major Cross Reference File.

Proposed File Content

Data Element	Byte	
Contractor Abbreviated Name	8	File Key
Pointer to Documents File	8	
Pointer to Expert File	8	
Pointer to Contracts File	8	
Pointer to Major Cross Reference File	8	
Contractor Full Name	30	
Contractor Address (Street, City, St)	35	
Zip Code	5	
Contractor Telephone Number	10	
INCA Participant	4	
Program Manager	30	

Record Field Definition

Contractor Abbreviated Name - abbreviated name of contractor to be used as access key

Contractor Full Name - Unabbreviated name of contractor

Contractor Address - Street, City, and State of contractor

Contractor Telephone Number - associated office telephone number

INCA Participant - INCA will appear if the contractor is an INCA participant otherwise blank.

10.3.1.3 Keyword Master File

Descriptive File Name: Keyword File

System File Name - RMKW

Related Variable Files

- Documents File
- Experts File
- Major Cross Reference File

Access Key - Keyword

Purpose: The Keyword File is incorporated in the Resources Data Base as a reference file so as to allow searches for codes, experts, documents, contractors and data bases via the use of word identifiers or descriptors associated with records in the various files. Conversely, this data base design can allow a listing of keywords related to any record in a file linked to the major cross reference file.

Proposed File Content:

Data Element	Bytes	
Keyword	18	File Key
Pointer to Experts File	8	
Pointer to Documents File	8	
Pointer to Major Cross Reference File	8	

10.3.1.4 Data Base Master File

Descriptive File Name: Data Base File

System File Name - RMDB

Related Variable Files

- Documents File
- Contracts File
- Major Cross Reference File

Access Key - Data Base Name

Purpose: The Data Base File contains the name and related information of data bases which are associated with nuclear effects data or codes. Specifically this file will be limited to nuclear effects on communications data bases (and data sets). The file is also designed to permit data sets of codes which, although not technically Data Bases, have valid to use-ful nuclear effects data. The Data Base File will have pointers to the documents file for data base reports and to the Major Cross Reference File for reference to associated codes, keywords, and contractors.

Proposed File Content

Data Element	Byte	
Data Base Acronym	6	File Key
Pointer to Documents File	8	
Pointer to Major Cross Reference File	8	
Data Base Full Name	20	

Data Element	Byte
Number of Records	5
Length of Records	5
Element List	To be determined
DB Description	To be determined
DBMS	11

Record Field Definition

Data Base Full Name - the expanded name of the data base

Number of Records
Length of Records } the data base storage and record structures are defined

Elements List - data parameter headings

DB Description - abstract of the purpose and function of the DB

DBMS - comment as to whether the Data Base Management System is commercial or proprietary

10.3.1.5 Acronym Master File

Descriptive File Name: Acronym File

System File Name - RMAC

Related Variable Files: None

Access Key - Acronym

Purpose: Many technical reports, codes, agencies, etc., are listed by their abbreviation or acronym. The Acronym File will expand acronyms to their full title if requested by the user. It will act as a single purpose data base and cannot be accessed via any other files in the RDB.

Proposed File Content

Data Element	Bytes	
Acronym (system, agency, code, etc.)	12	File Key
Expanded Title	50	

10.3.2 RDB Variable Files

Variable files hold information common to one or more master files as well as to cross-reference two or more master files. The RDB uses four variable files in the architecture design. Logical file structure for the variable files is shown in Figures 10-6 through 10-8.

10.3.2.1 Documents Variable File

Descriptive File Name - Document File

System File Name - RVDC

Purpose: The Documents File contains a listing of documents produced for or relating to the keywords, codes, and/or data bases specified for the INCA Resources Data Base. This variable file is therefore logically to be accessed by the Code File, Contractor File, Keyword File, and/or Data Base File.

The Documents File will contain report title and number, security classification, and other associated information listed below.

Proposed File Content

Data Element	Bytes	
Code Name (Acronym)	8	Key
Contractor Name (Abbrev)	8	Key
Keyword	To be determined	Key
Data Base (Acronym)	To be determined	Key
Report Title	65	
Report Number	12	
Date Issued	14	
Page Count	4	
Security Classification	4	
Distribution Status	50	
Original/Revision	8	
DNA Call Number	11	
DDC#	11	

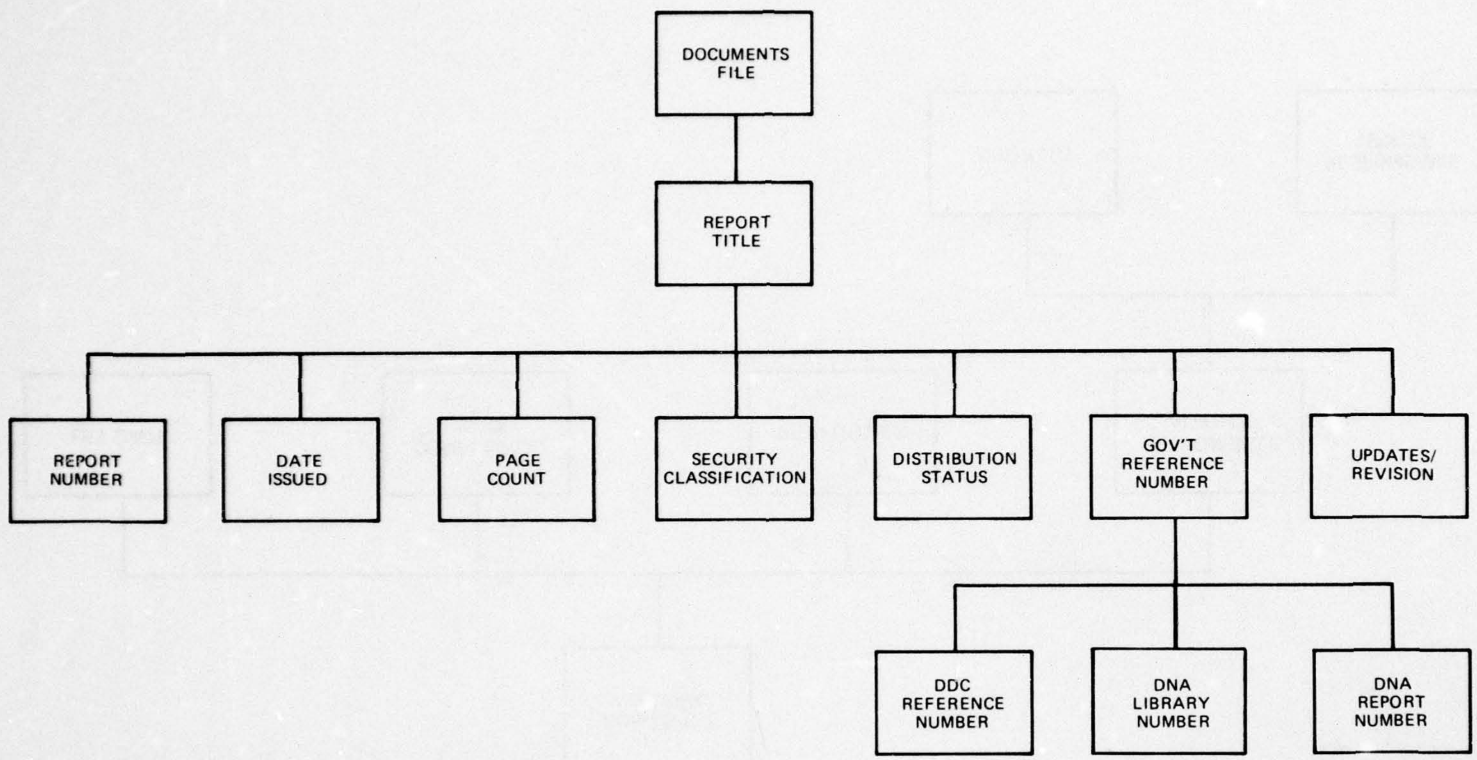


Figure 10-6. Documents File Logical Structure

AD-A058 405 COMPUTER SCIENCES CORP FALLS CHURCH VA F/G 17/2.1

INTEGRATED NUCLEAR COMMUNICATIONS ASSESSMENT DATA BASE EVALUATI--ETC(U)

JAN 78 H A BLANK, P C WOOD, J A CAMPBELL DNA001-77-C-0115

UNCLASSIFIED CSC-4511-00300 DNA-4352T-1A NL

2 OF 2

ADA 058405

END

DATE FILMED

10-78

DDC

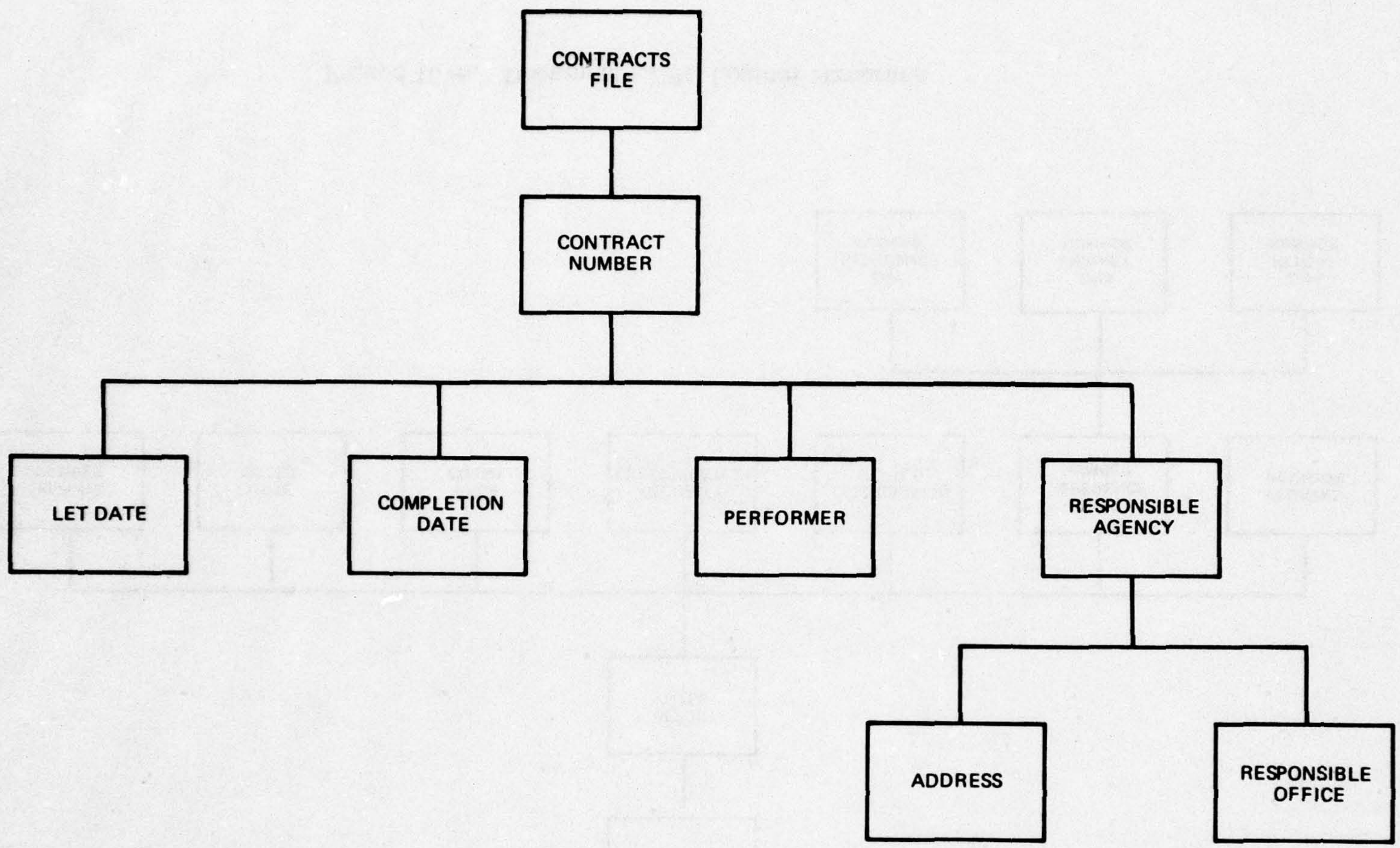


Figure 10-7. Contracts File Logical Structure

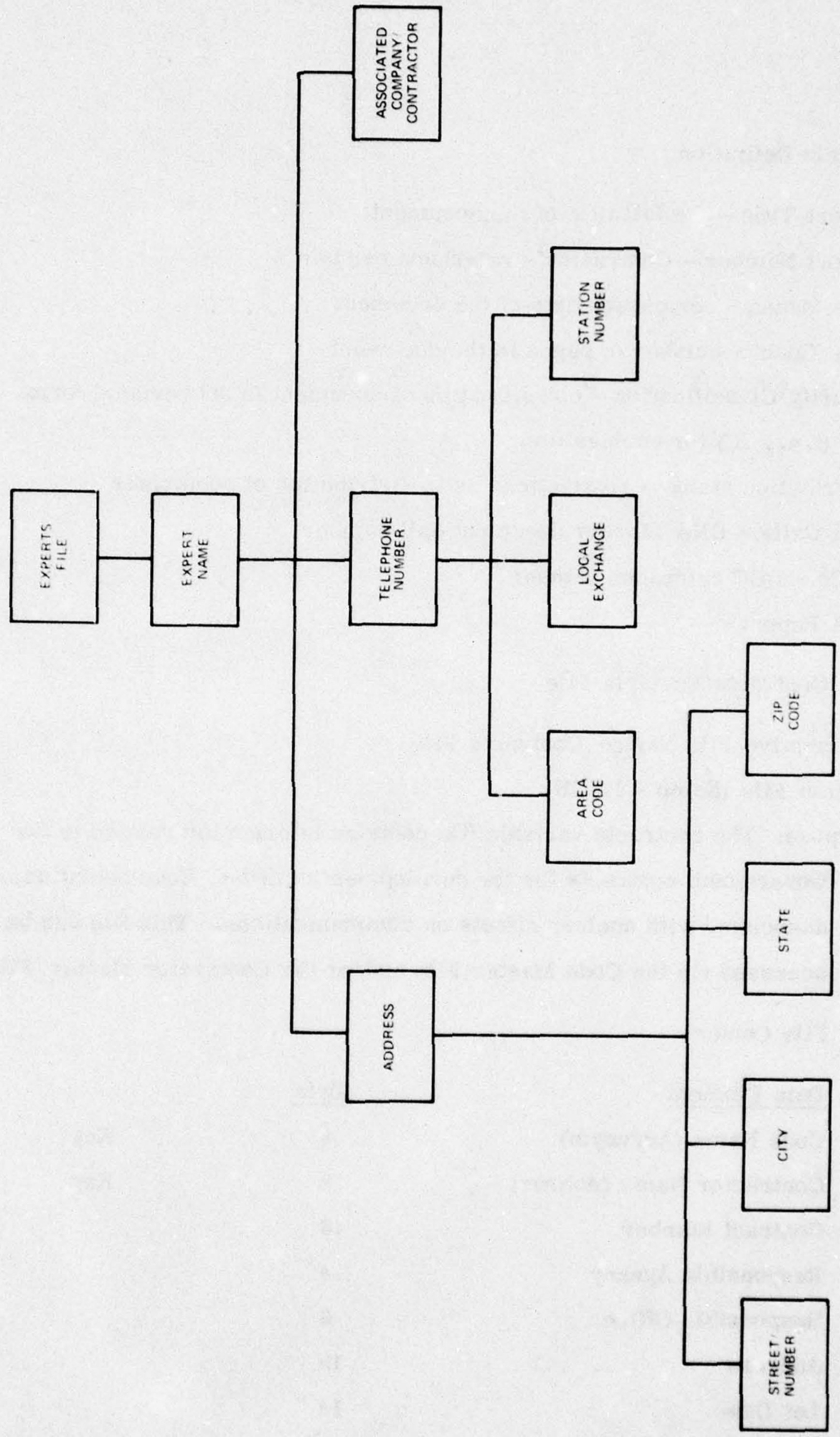


Figure 10-8. Experts File Logical Structure

Record Field Definition

Report Title - the full title of the document

Report Number - Contractor's reference number

Date Issued - completion date of the document

Page Count - number of pages in the document

Security Classification - classification of document in abbreviated form (i.e., (U) for unclassified)

Distribution status - restrictions as to distribution of documents

DNA Call# = DNA Library document call number

DDC# - DDC reference number

DNA Report # -

10.3.2.2 Contracts Variable File

Descriptive File Name: Contracts File

System File lName - RVCN

Purpose: The contracts variable file contains information related to the Government contracts for the development of codes, documentation, etc. associated with nuclear effects on communications. This file can be accessed via the Code Master File and/or the Contractor Master File.

Proposed File Content

Data Element	Byte	
Code Name (Acronym)	8	Key
Contractor Name (Abbrev)	8	Key
Contract Number	16	
Responsible Agency	4	
Responsible Office	6	
Address	15	
Let Date	14	
Completion Date	14	
Performer	30	

Record Field Definition

Report Title - the full title of the document

Report Number - Contractor's reference number

Date Issued - completion date of the document

Page Count - number of pages in the document

Security Classification - classification of document in abbreviated form (i.e., (U) for unclassified)

Distribution status - restrictions as to distribution of documents

DNA Call# - DNA Library document call number

DDC# - DDC reference number

10.3.2.2 Contracts Variable File

Descriptive File Name: Contrats File

System File Name - RVCN

Purpose: The contracts variable file contains information related to the Government contracts for the development of codes, documentation, etc. associated with nuclear effects on communications. This file can be accessed via the Code Master File and/or the Contractor Master File.

Proposed File Content

Data Element	Byte	
Code Name (Acronym)	8	Key
Contractor Name (Abbrev)	8	Key
Contract Number	16	
Responsible Agency	4	
Responsible Office	6	
Address	15	
Let Date	14	
Completion Date	14	
Dollar Amount	13	

10.3.2.3 Experts Variable File

Descriptive File Name - Experts File

System File Name - RVEX

Purpose: The Experts File contains a list of personnel with expertise regarding any category included in this data base. Listed with the name is the location and telephone number. The file contains keys such that the file can be accessed by the Code File, Contractor File, and/or Keyword File.

Proposed File Content:

Data Element	Bytes	
Code Name	8	Key
Contractor Name (Abbrev)	8	Key
Keyword	To be determined	Key
Personnel Name	20	
Personnel Address	35	
Personnel Telephone Number	10	

Note: Fields for Expert File are self explanatory.

10.3.2.4 Major Cross Reference Variable File

Descriptive File Name: Reference File

System File Name - RVMC

Purpose: The Cross Reference File is incorporated in the Resources Data Base Design to accommodate file structure for a DBMS (Data Base Management System) that does not provide direct inter-file access. For example, TOTAL DBMS allows direct link paths from Master to Variable Files but not to other Master Files. The cross reference variable file therefore, provides link paths between Master Files.

The cross reference file will provide key fields which contain access keys to other Master Files.

Proposed File Content

Data Element	Bytes	
Code Name (Acronym)	6	Key
Contractor Name (Abbrev)	8	Key
Keyword	To be determined	Key
Data Base (Acronym)	6	Key

Note: Data items can be included after each key.

SECTION 11 - CONCLUSIONS AND RECOMMENDATIONS

11.1 CONCLUSIONS - TASDB

The TASDB will centralize the data repository function for the INCA program as well as ensure the quality of data elements used in technical analyses. Only if a strong data base management philosophy is adopted can the latter be assured. Centralization reduces costs of data acquisition for new and continuing INCA participant efforts. As new data is produced by analyses, system assessment simulations, etc., it will be fed back into the data base system for other references (assuming the results are of general applicability). No quantitative cost estimates of savings were made, but qualitative considerations from a field survey show that there is repetitive expenditures for similar or identical data collection efforts currently.

Two features of data base management systems application are the common storage of redundant data elements and the direct links between related records of distinct data files. The former reduces storage charges for INCA data while the latter reduces CPU charges in that CPU time is reduced. Reduction of CPU time is effected by removing the data file sort requirement and linking related data records. When a request is made for one data element or record, all others related to it are "instantly" located, hence, no sort of other files to find matching record identifiers.

Use of the data record links also reduces programming efforts since sorts and file processing are reduced or eliminated. As well the data base itself is isolated from the application programs by the data base management system. Consequently, no specific I/O programming is required for access to data files and since there is none, any data base reorganization will not impact application programs (provided the data is still stored somewhere; not deleted in anyway). Reorganization can be to the record level and still maintain this advantage of no impact in application programs.

Therefore, a DBMS implemented at this time saves INCA program monies due to:

- Reduced data collection costs in the future
- Reduced programming efforts
- Better data quality (making technical analyses more useful per dollar expenditure)

11.2 CONCLUSIONS - RESOURCE DATA BASE

While the advantages of a DBMS system apply here as well as for the TASDB, further commentary is applicable. Redundant analytical efforts, resource location costs, man-power effectiveness are all aspects of creating a more cost-effective INCA program. During the time period CSC has been involved with the INCA program and during the data base survey, the necessity for an automated management information system regarding resources and relevant prior work became evident. Composite data files were selected and the data records cross-referenced in order to create an efficient system for the benefit of the INCA participants and ultimately, the INCA program itself.

11.3 RECOMMENDATIONS

CSC recommends that a final cost-benefit analysis be made which will measure the data base system concepts and design generated against current and future INCA program efforts. This is not anticipated to be either a lengthy or costly study, but rather to demonstrate clearly that the designed data base system is clearly cost-effective to implement at this time or at a later point in time.

Assuming that the analysis proves it is cost-effective to make this INCA program investment and at this time, CSC recommends that the Defense Nuclear Agency take strong action to establish the INCA Data Base System at the time frame the analysis shows to be most cost-effective, be it immediately or a future point in time.

We make this recommendation in view of the fact that the Defense Nuclear Agency and the INCA program are long term entities, and therefore, will be substantially involved in repetitive data collection and analysis of the identical or similar data, differing from INCA task to task only on its organization and usage.

APPENDIX A
PROTOTYPE INCA DATA BASE RECORD FORMATS & CODES

Reference was made in the report to the Prototype INCA Data Base System, as set up on an IBM-370/155 at the Defense Communications Agency in Reston, Virginia. This appendix provides detail on the record formats and data element values used in the Prototype. Data so described is standard according to DCA Circular 310-65-1, Circuit/Trunk File - Data Elements and Codes Manual of the Defense Communications System and is a subset of the total data elements in that file. Distribution between the Prototype Data Base System and this file is that the former is a time automated data base while the latter is a sequential record organization of a bookkeeping nature which requires much file handling compared to a data base system for access to related data elements.

Tables A-1 through A-6 show the record format for each of the four master files and two variable files in the data base. All remaining tables illustrate the content of the fields in these records. Data is oriented toward the CONUS-EUROPE portion of the DCS.

Table A-7 and Figure A-1 shows the trunk identifier codes and the meaning of the various component character positions in the identifier.

Table A-8 states the Trunk Service Availabilities codes used.

Table A-9, In/Out Flag Codes, was a field set up for use by a circuit/trunk assessment model developed for the Trunk Allocation Assessment Task.

Table A-10 Facility Codes states the standard facility codes selected for use in the Prototype Data Base.

Table A-11, Command Communications Service Designator indicates the definition of the component character positions of the Command Communications Service Designator (CCSD).

Table A-12, Circuit Service Availability, indicates availability of circuit for use as per standard DCA definitions.

Table A-13, Routing Applied, indicates the specific routing policy applied to a given circuit.

Table A-14, Sites Contained in Data Base, giving a list of all sites loaded into the data base for the Trunk Allocation Assessment Task Groups. Included are state/country codes, the facility located at the site, abbreviated site name, location and geographics co-ordinates.

Table A-15, Link Identification, indicates the definition of the component character positions of the Link Identifier.

Table A-16, Transmission Media, gives the media codes and definitions of those transmission media included in the data base.

Table A-17, Link Code, gives the code and definition for various link classifications used in the data base.

Table A-1. RMTR Record Structure

RMTRROOT	RMTRCTRL	RMTRLKCT	RMTRLKTL	RMTR FLAG	RMTRRCAT	RMTRFRLC	RMTRTOLC	RMTRTCAP	RMTRBAND	RMTRAVAL	RMTRFFAC	RMTRTFAC	RMTRFILL
1	9	16	24	32	33	34	42	50	54	59	62	65	68

Description of Data Elements

Columns		
1-8	RMTRROOT	Internally generated address, used by TOTAL
9-15	RMTRCTRL	Record key, consisting of trunk identifier and service availability, see Tables 1 and 2
16-23	RMTRLKCT	Internally generated linkage to RVCT (cross-reference of circuits, trunks and sites)
24-31	RMTRLKTL	Internally generated linkage to RVTL (cross-reference of trunks, links and sites)
32	RMTRFLAG	Flag indicating operational status of trunk, see Table 3
33	RMPRRCAT	Restoration category of trunk, as assigned by DCA, where 1 indicates first restored; 2, second; 3, third; 4, fourth and 0, last.
34-41	RMTRFRLC	Site at which the trunk originates, abbreviated in accordance with DCA codes
42-49	RMTRTOLC	Site at which the trunk terminates, abbreviated in accordance with DCA codes
50-53	RMTRTCAP	Trunk capacity in terms of the number of channels
54-58	RMTRBAND	Bandwidth
59-61	RMTRAVAL	Number of channels available
62-64	RMTRFFAC	Type of facility at which trunk originates, see Table 4
65-67	RMTRTFAC	Type of facility at which trunk terminates, see Table 4
68-71	RMTRFILL	Unused space; available for possible future use

Record length = 71
Blocking factor = 90
Maximum no. of records = 180
Total no. of tracks = 1

Table A-2. RMCT Record Structure

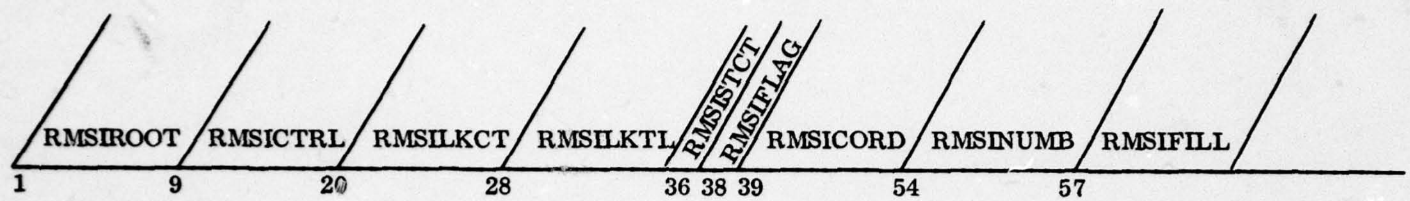
RMCTROOT	RMCTCTRL	RMCTLKCT	RMCTFLAG	RMCTRSTP	RMCTFRLC	RMCTTOLC	RMCTRAPL	RMCTTIDEN	RMCTXREF	RMCTFFAC	RMCTTFAC	RMCTFILL
1	9	18	26	27	29	37	45	46	47	55	58	61

Description of Data Elements

Columns		
1-8	RMCTROOT	Internally generated address, used by TOTAL
9-17	RMCTCTRL	Record key, consisting of Command Communications Service Designator (CCSD) and service availability, see Tables 5 and 6
18-25	RMCTLKCT	Internally generated linkage to RVCT (cross-reference of circuits, trunks and sites)
26	RMCTFLAG	Flag indicating operational status of circuit, see Table 3
27-28	RMCTRSTP	Restoration priority of the circuit, indicating the relative importance of the circuit for restoral actions. These are assigned by DCA. In order of importance (most to last): 1A, 1B,...,1G, 2A,..., 2I, 3A, 3B, 3C, 4A, 4B, 00
29-36	RMCTFRLC	Site at which the circuit originates, abbreviated in accordance with DCA standards
37-44	RMCTTDLC	Site at which the circuit terminates, abbreviated in accordance with DCA standards
45	RMCTRAPL	Type of circuit routing applied, see Table 7
46	RMCTIDEN	Flag set to 1 if circuit is multiplexed within another circuit; set equal to C if circuit is described as a trunk; blank otherwise
47-54	RMCTXREF	If RMCTIDEN = 1 then this field contains the circuit CCSD, if RMCTIDEN = C this field contains the trunk identifier; otherwise blank
55-57	RMCTFFAC	Type of facility at which the circuit originates, see Table 4
58-60	RMCTTFAC	Type of facility at which the circuit terminates, see Table 4
61-64	RMCTFILL	Unused space; available for possible future use

Record length = 64
Blocking factor = 100
Maximum no. records = 600
Total no. of tracks = 3

Table A-3. RMSI Record Structure

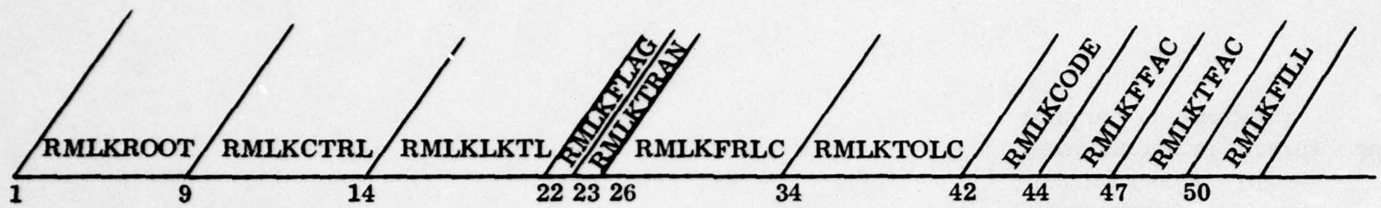


Description of Data Elements

Columns	Name	Description
1-8	RMSIROOT	Internally generated address, used by TOTAL
9-19	RMSICTRL	Record key, consists of abbreviated location name and facility code, see Tables 8 and 4
20-27	RMSILKCT	Internally generated linkage to RVCT (cross-reference of circuits, trunks and sites)
28-35	RMSILKTL	Internally generated linkage to RVTL (cross-reference of trunks, links and sites)
36-37	RMSISTCT	State or country of location, see Table 8
38	RMSIFLAG	Flag indicating operational status of site, see Table 3
39-53	RMSIFLAG	Latitude and longitude of site
54-56	RMSINUMB	Numerical code assigned to location for ease in programming, see Table 8
57-63	RMSIFILL	Unused space; available for possible future use

Record length = 63
Blocking factor = 102
Maximum no. of records = 204
Total no. of tracks = 1

Table A-4. RMLK Record Structure



<u>Description of Data Elements</u>

Columns	Name	Description
1-8	RMLKROOT	Internally generated address, used by TOTAL
9-13	RMLKCTRL	Record key, consisting of link identification, see Table 9
14-21	RMLKLKTL	Internally generated linkage to RVTL (cross-reference of trunks, links, and sites)
22	RMLKFLAG	Flag indicating operational status of link, see Table 3
23-25	RMLKTRAN	*Transmission media code*, see Table 10
26-33	RMLKFRLC	One endpoint of link, abbreviated in accordance with DCA codes
34-41	RMLKTOLC	One endpoint (not same as RMLKFRLC) of link
42-43	RMLKCODE	Code assigned to link for ease in programming, see Table 11
44-46	RMLKFFAC	Type of facility at RMLKFRLC, see Table 4
47-49	RMLKTFAC	Type of facility at RMLKTOLC, see Table 4
50-51	RMLKFILL	Unused space; available for possible future use

Table A-5. RVCT Record Structure

RVCTRMCT	RMCTLKCT	RVCTRMTR	RMTRLKCT	RVCTRMSI	RMSILKCT	RVCTTOLC
1	10	18	25	33	44	52

59

Description of Data Elements

Columns	Name	Description
1-9	RVCTRMCT	CCSD and service availabilty; record key of RMCT (see Tables 5 and 6)
10-17	RMCTLKCT	Internally generated linkage to RMCT (Circuit Data File)
18-24	RVCTRMTR	Trunk identifier and service availability; record key of RMTR (see Tables 1 and 2)
25-32	RMTRLKCT	Internally generated linkage to RMTR (Trunk Data File)
33-43	RVCTRMST	Site name (abbr.) and facility code; record key of RMSI (see Tables 8 and 4)
44-51	RMSILKCT	Internally generated linkage to RMSI (Site Data File)
52-59	RVCTTOLC	Site at which circuit segment terminates

Record length = 59
Blocking factor = 109
Maximum no. records = 3052
Total no. of tracks = 14

Table A-6. RVTL Record Structure

RVTLRMTR	RMTRLKTL	RVTLRMSI	RMSILKTL	RVTLRMLK	RMLKLKTL	RVTLTOLC
1	8	16	27	35	40	48

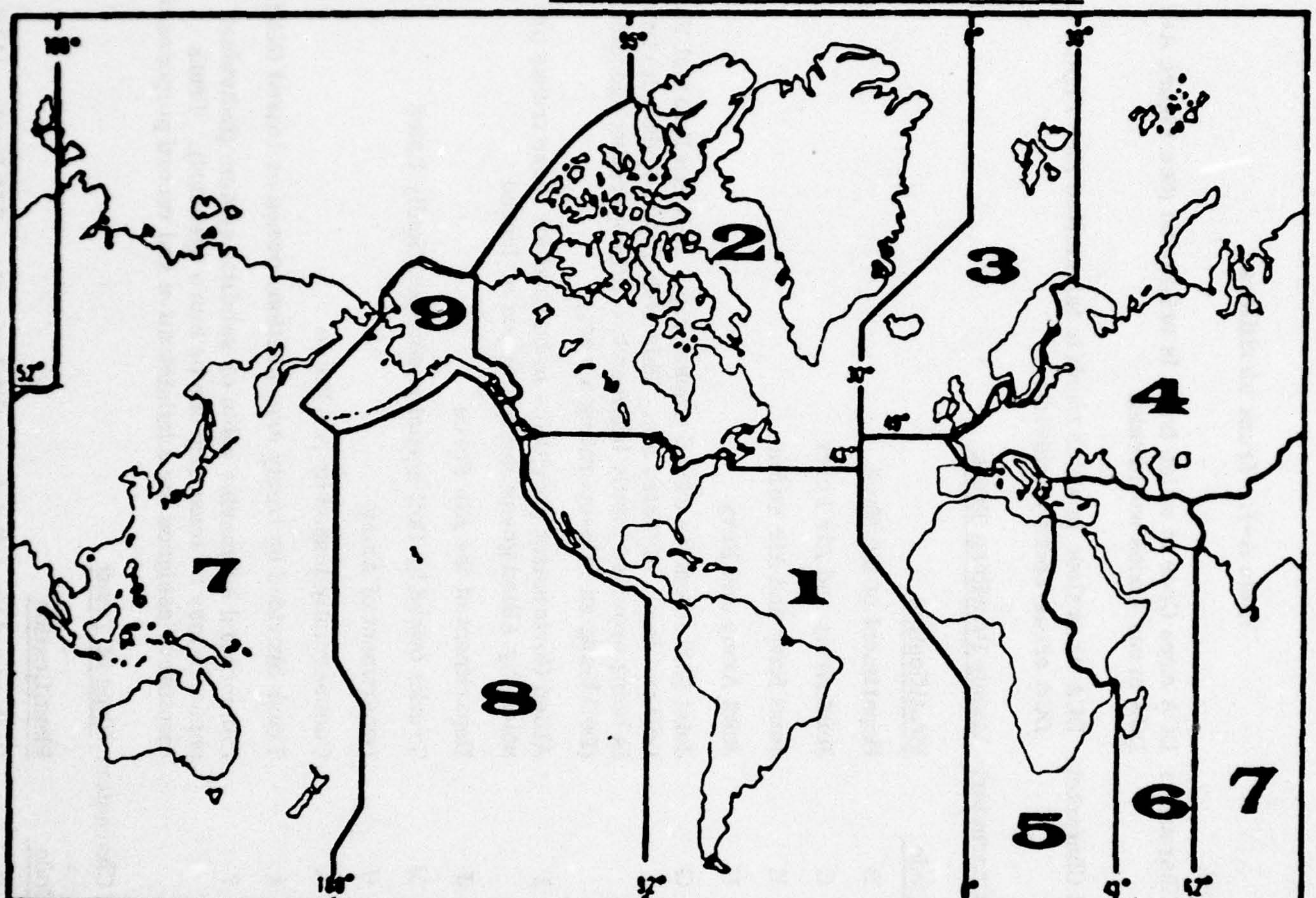
Description of Data Elements

Columns	Name	Description
1-7	RVTLRMTR	Trunk identifier and service availability; record key of RMTR (see Tables 1 and 2)
8-15	RMTRLKTL	Internally generated linkage to RMTR (Trunk Data File)
16-26	RVTLRMSI	Site name (abbr.) and facility code; record key of RMSI (see Tables 8 and 4)
27-34	RMSILKTL	Internally generated linkage to RMSI (Site Data File)
35-39	RVTLRMLK	Link identification; record key of RMLK (see Table 9)
40-47	RMLKLKTL	Internally generated linkage to RMLK (Link Data File)
48-55	RVTLTOLC	Site at which trunk trailer (segment) terminates

Record length = 55
Blocking factor = 117
Maximum no. records = 468
Total no. of tracks = 2

Figure A-1. Trunk Identifier

First and second characters: <u>Areas codes of origin and termination</u>



LEGEND AREAS 1, 2, and 9 - WESTERN HEMISPHERE; AREAS 7 AND 8 - DCA-PACIFIC; AREAS 3, 4, 5, AND 6 - DCA-EUROPE

Table A-7. Trunk Identifiers

First Character: DCA Area Code in which trunk is originated (See Figure A-1 of DCA areas/codes worldwide)

Second Character: DCA Area Code in which trunk is terminated (See Figure A-1 of DCA areas/codes worldwide)

Third Character: Agency Providing Trunk

Code	Identification
B	Department of the Navy
C	Joint Army and Air Force
E	Joint Navy and Air Force
F	Joint Army and Navy
G	Joint NCS Agencies owned trunks; e.g., between DoD and FAA, DoD and Dept. of State, etc. This code is used when the trunk is being provided jointly between two NCS operating agencies (DoD being an NCS-operating agency)
I	Allied Government provided - to be used for those trunks provided solely by Allied governments, owned or leased
J	Department of the Air Force
M	Trunks owned by DoD agencies not specifically listed
U	Department of Army
X	Commercially leased by Air Force
4	Trunk provided by treaty organization, owned or leased (NATO only)
7	Commercial submarine cable or satellite system (individual channels may be leased by one or more agencies). Trunk identifiers assigned for administrative and record purposes only

Fourth Character: Type of Trunk

Code	Identification
C	High-speed time division multiplex system (150 baud and higher channel subdivision)
I	Speech plus system

Table A-7. Trunk Identifiers (Cont'd)

Code	Identification
J	Low-speed time division multiplex system (less than 150 baud channel subdivision)
M	Microwave
Q	Submarine cable
R	Landline cable
S	Satellite relay
T	Forward propagation tropospheric scatter (FPTS)
X	VFCT system not provided via HF systems
Y	VFCT provided via HF or combination HF, wideband
Z	Composite system (nonsimilar media)
8	Non-DCS satellite trunk

NOTE: A composite system (nonsimilar media) is a mixed system whereby a combination of microwave, tropo, landline, etc., is used to support one trunk. This type system will carry a "Z" type trunk code. The only exceptions are trunks with submarine cable (Q), HF (B), or satellite (S) transmission media.

Table A-8. Trunk Service Availability

Code	Identification
A	Full period (18-24 hr/day)
C	Six hours or less
E	Available 6-12 hr.
F	Available 12-18 hr.
G	On call. Activated by callup from either trunk terminal
H	First programmed reroute
J	Second programmed reroute
Q	On call caretaker status. Activated only as directed by proper authority
U	On call hot standby
V	Contingency

Table A-9. In/Out Flag Codes

Code	Identification	
A	In service	Time Period 1
B	5-minute outage	
C	15-minute outage	
D	30-minute outage	
E	60-minute outage	
F	90-minute outage	
G	Permanent outage	
H	(available for future assignment)	
J	In service	Time Period 2
K	5-minute outage	
L	15-minute outage	
M	30-minute outage	
N	60-minute outage	
O	90-minute outage	
P	Permanent outage	
Q	(available for future assignment)	
S	In service	Time Period 3
T	5-minute outage	
U	15-minute outage	
V	30-minute outage	
W	60-minute outage	
X	90-minute outage	
Y	Permanent outage	
Z	(available for future assignment)	

Table A-10. Facility Codes

Code	Description
ACA	Army Communications Center
ACF	Forward Air Control Post
AER	Aeronautical Station
AFN	Armed Forces Network
ATE	Army Terminal
ATF	Air Force Terminal
BFC	Navy Technical Control Facility
BOR	On-Line Relay Facility
CCI	Commercial Communications Interface
CCM	CRITICOMM Station
CCT	Communications Center
CHD	Submarine Cable Head
CIC	CINC Atlantic Fleet (CINCANTFLT)
CPA	Command Post
CRY	Crypto Station
CST	Commercial Satellite (COMSAT) Terminal
CTD	Commercial Terminating Point
CTP	Circuit Tie Point
DPC	AUTODIN General Purpose Terminal
GTY	Gateway Facility for Submarine Cable
MDF	Main Distribution Frame
MRS	Microwave Repeater Site
MSU	AUTODIN Message Switch
NTE	NATO Satellite System Earth Terminal
NTS	NATO, U.S. Element
OCA	Operations Center
OSS	Overseas Switchboard
PTF	Patch and Test Facility
RCE	Army Receiver Station
RLT	Radio Terminal (w/o Technical Control)
RRS	Radio Relay Station
RSA	Radio Site
SAT	Satellite Relay
SCA	AUTOVON Switching Facility
SHC	Ship Communications Facility
SPE	Supreme Headquarters Allied Powers Europe (SHAPE)
SVT	AUTOSEVOCOM 758 Switch
SWB	Switchboard
SYT	Defense Satellite Communications System Earth Terminal
TBA	Telephone Company Building

Table A-10. Facility Codes (Cont'd)

Code	Description
TBD	Command Switchboard
TCA	Traffic Control Agency
TCF	Air Force Technical Control Facility
TCG	Army Technical Control Facility
TCL	Technical Control
TCM	Technical Control Facility Limited Capability
TRS	Transmitter Site
TXL	Army Transmitter Station
WWM	World Wide Military Command and Control System (WWMCCS) Center
ZAZ	National Military Command Center (NMCC)

Table A-11. Command Communications Service Designator (CCSD)

First Character: Agency Code (of organization requiring the circuit)

B	Department of the Navy
C	National Command Authority (JCS)
D	Defense Communications Agency
J	Department of the Air Force
N	DoD Agencies not listed, e.g., DIA, NSA, DLA, DNA
O	Host-country - for all circuits required by any country who is host to U.S.
U	Department of the Army

Second and Third Characters: Purpose and Use Code

DJ	National Military Command and Control Voice Network
DM	Emergency Message Automatic Transmission System (JCS)
DN	Critical Intelligence Communications
DW	USAFE Headquarters Command and Control
KR	ANMCC Network
KX	NMCC Teletypewriter Network
KZ	NMCS Data Transmission
QA	MAC Command Control Record Communication System
QM	MAC Command Control Voice Circuits
TL	Low-Speed TDM System (below 150 baud)
TP	Speech Plus System
TX	VFCT System
TY	High-speed TDM System (150 baud and over)
UA	Command User Teletypewriter Service
UB	Common User Voice Service
UD	DCS AUTOSEVOCOM/SEVOCOM Voice Communications Network Circuits

Table A-11. Command Communications Service Designator (CCSD) (Cont'd.)

UE	Common User Digital Data (excluding teletype)
UL	DCS Automatic Record Communications Network Circuits
UM	Special Purpose Network
UU	DCS Automatic Voice Network Circuits
WC	World Wide Command and Control System
YK	Sage AUTOVON Switched Network

Fourth Character: Type Service Code

A	Teletype Service other than DCS Switched Networks
B	AUTOVON Access Line
C	AUTOVON Interswitch Trunk
D	Data other than DCS Switched Networks
E	AUTODIN Access Line
F	AUTODIN Interswitch Trunk
H	AUTOSEVOCOM Interswitch Trunk
L	DSSCS AUTODIN Access Line
N	AUTOVON Access Line serving an AUTOSEVOCOM subscriber or switch
V	Voice other than DCS Switched Networks
X	Package System Channel accounting by DCA

Fifth through Eighth Characters: Circuit number; blocks are assigned to area centers and certain agencies

IAAA-IZZ7	Manager, NCS or GSA	RAAA-R999	DCA, reserved
BAAA-B999	DCA Hq.	6N0A-6N99	DCAOC A&E DIV
25AA-2599	DIA (DCA Europe)	20AA-2499	DCA Hq
AAAA-A999	DCAOC A&E DIV	26AA-2999	DCA Hq
FAAA-F999	DCAOC A&E DIV		

Table A-12. Circuit Service Availability

A	Full period (18 hours or more)
F	Available 12-18 hours
G	On call (activated upon request of user)
H	Programmed reroute
M	Engineered military circuit

Table A-13. Routing Applied

Code	Meaning
A	Preferred routing
B	Reserved
C	Nonpreferred route specified by user to meet operational requirement
D	Route required due to system loading criteria of optimum route
E	Route required due to lack of equipment at certain stations
F	Route used because channel fill precluded using optimum route
G	Route used due to user required DCS/non-DCS interface or routing control point
H	Route used due to required commercial/DCS interface or routing control point
I	Route required by engineering technical criteria
J	Temporary exercise circuit
K	Temporary test circuit
L	Temporary peak traffic overload circuit
M	Cost effective routing

Table A-14. Sites Contained in Data Base

ST CRTY	FAC CODE	ABBREV NAME	LOCATION NAME	COORDINATES		NUMBER
ZY	SHC	AFLOAT	AFLOAT			01
ZY	CCT	AFLOAT	AFLOAT			02
UK	TCF	ALCONBRY	ALCONBURY	522225N	0001310W	03
23	CST	ANDOVER	ANDOVER	443900N	0704700W	04
24	TCF	ANDREWS	ANDREWS	384839N	0765202W	05
24	TRS	ANNAPOLS	ANNAPOLIS	385900N	0763000W	06
51	SCA	ARLINGTN	ARLINGTON	385500N	0771000W	07
IR	CST	ASADABAD	ASADABAD	344700N	0480700E	08
SH	CST	ASCENSIN	ASCENSION	075700S	0142100W	09
ET	SYT	ASMARA	ASMARA	151900N	0385500E	10
ET	TCL	ASMARA	ASMARA	151900N	0385500E	11
GR	TCF	ATHENS	ATHENS	375900N	0234300E	12
IT	NTE	AURELIA	AURELIA	415300N	0122300E	13
UK	RRS	BARKWAY	BARKWAY	520600N	0000300W	14
UK	RRS	BOTLYHLL	BOTLEY HILL	511650N	0000003E	15
UK	RSA	BOVINGDN	BOVINGDON	514234N	0003243W	16
SP	CST	BUITRAGO	BUITRAGO	410000N	0033800W	17
CA	TCF	C DYER	CAMP DYER	663700N	0611800W	18
34	SCA	CEDARBRK	CEDAR BROOK	394200N	0745400W	19
UK	RSA	CHELVSTN	CHELVESTON	521813N	0003200W	20
08	TCF	CHYNNMTN	CHEYENNE MTN	384900N	1044300W	21
08	CTP	CHYNNMTN	CHEYENNE MTN	384900N	1044300W	22
CA	CHD	CLARNVLL	CLARENVILLE	494400N	1154700W	23
SP	CHD	CONIL	CONIL	361600N	0060500W	24
IT	TCL	COLTANO	COLTANO	433925N	0102432E	25
CA	CHD	CORNRBRK	CORNER BROOK	483300N	0583300W	26
PO	NTE	CSTDCPRC	COSTA DA CAPARICA	383800N	0091300W	27
UK	TCF	CROUGHTN	CROUGHTON	515930N	0011123W	28
UK	RSA	DAVENTRY	DAVENTRY	521248N	0010550W	29
TU	ATF	DIYARBKR	DIYARBAKIR	375400N	0401300E	30
TU	SYT	DIYARBKR	DIYARBAKIR	375400N	0401300E	31
GE	TCL	DNNRSBRG	DONNERSBERG	493630N	0075535E	32
51	SCA	DRANSVLL	DRANESVILLE	390000N	0771900W	33
GL	TCF	DYE 1	DYE 1	663700N	0530000W	34
GL	TCF	DYE 2	DYE 2	662901N	0461725W	35
GL	TCF	DYE 3	DYE 3	653300N	0374200W	36
GL	TCF	DYE 4	DYE 4	653300N	0374200W	37
IC	TCF	DYE 5	DYE 5	635734N	0224316W	38
NO	NTE	EGGEMOEN	EGGEMOEN			39
TU	TCF	ELMADAG	ELMADAG	395700N	0324100E	40
SP	CHD	ESTEPONA	ESTEPONA	362600N	0050800W	41
54	CST	ETAM	ETAM	391500N	0794500W	42
GE	NTE	EUSKRCHN	EUSKIRCHEN	504000N	0064700E	43
38	TBA	FARGO	FARGO	465200N	0964600W	44
GE	TCF	FELDBERG	FELDBERG	501432N	0082947E	45
GE	ACF	FELDBERG	FELDBERG	501432N	0082947E	46
24	MSU	FTDETRCK	FORT DETRICK	392600N	0772100W	47
24	SYT	FTDETRCK	FORT DETRICK	392600N	0772100W	48
24	TCG	FTDETRCK	FORT DETRICK	392600N	0772100W	49
24	TCM	FT MEADE	FORT MEADE	390600N	0764300W	50
24	TCG	FTRITCHI	FORT RITCHIE	394400N	0772500W	51
24	WWM	FTRITCHI	FORT RITCHIE	394400N	0772500W	52
GE	AFN	FRANKFRT	FRANKFURT	500700N	0084100E	53
GE	GTY	FRANKFRT	FRANKFURT	500700N	0084100E	54
GE	TCG	FRANKFRT	FRANKFURT	500700N	0084100E	55
GE	RSA	FRIOLZHM	FRIOLZHEIM			56
IT	CST	FUCINO	FUCINO	464900N	0104300E	57
UK	TCF	FYLNGDLS	FYLINGDALES MOOR	542100N	0004000W	58
30	SCA	GLENDIVE	GLENDIVE	470800N	1044100W	59
UK	CST	GNHLYDWN	GOONHILLY DOWNS	500258N	0051029E	60
44	CHD	GREENHLL	GREEN HILL			61
GE	MDF	HEIDLBRG	HEIDELBERG			62
GE	TCG	HEIDLBRG	HEIDELBERG			63
UK	SCA	HILLNGDN	HILLINGDON	513800N	0002600W	64
UK	TCF	HILLNGDN	HILLINGDON	513800N	0002600W	65
IC	TCF	HOFN	HOFN	641430N	0145750W	66
SP	SCA	HUMOSA	HUMOSA	402954N	0031512E	67

Table A-14. Sites Contained in Data Base (Cont'd)

ST CRTY	FAC CODE	ABBREV NAME	LOCATION NAME	COORDINATES		NUMBER
CA	CHD	INDNHRBR	INDIAN HARBOUR			068
TU	TCF	KARATAS	KARATAS			069
IC	BFC	KEFLAVIK	KEFLAVIK			070
IC	CCM	KEFLAVIK	KEFLAVIK			071
IC	SWB	KEFLAVIK	KEFLAVIK			072
MO	CTP	KENITRA	KENITRA	341806N	0063549W	073
MO	MCE	KENITRA	KENITRA	341806N	0063549W	074
MO	SWB	KENITRA	KENITRA	341806N	0063549W	075
GE	TCG	KONGSTHL	KOENIGSTHUL			076
CA	CCI	LDYFNKLN	LADY FRANKLIN	683000N	1131000W	077
CA	TCA	LDYFNKLN	LADY FRANKLIN	683000N	1131000W	078
PO	SYT	LAJES	LAJES			079
PO	TCF	LAJES	LAJES			080
34	SYT	LAKEHRST	LAKEHURST	400200N	0742100W	081
GE	ATE	LANDSTHL	LANDSTHUL	492500N	0073400E	082
GE	SYT	LANDSTHL	LANDSTHUL	492500N	0073400E	083
GE	TCF	LANGRKPF	LANGERKOPF	491804N	0075122E	084
BE	CST	LESSIVE	LESSIVE			085
UK	BFC	LONDON	LONDON	513100N	0000600W	086
UK	GTY	LONDON	LONDON	513100N	0000600W	087
UK	RLT	LONDON	LONDON	513100N	0000600W	088
TU	TCF	MALATYA	MALATYA			089
MO	CST	MARRAKCH	MARRAKECH			090
UK	TCF	MTLSHMHT	MARTLESHAM HEATH	521000N	0012000E	091
34	CPA	MCGUIRE	MCGUIRE			092
IT	RRS	MT CORNA	MOUNT CORNA			093
GR	TCF	MTPARNIS	MOUNT PARNIS			094
GR	TCL	MTPATERS	MOUNT PATERAS	380358N	0232237E	095
IT	SCA	MTVERGIN	MOUNT VERGINE	405600N	0144300E	096
IT	TCL	MTVERGIN	MOUNT VERGINE	405600N	0144300E	097
UK	TCF	MRMNDHLL	MORMOND HILL	573608N	0020200W	098
UR	CST	MOSCOW	MOSCOW	554500N	0374200E	099
51	SCA	MOSELEY	MOSELEY	372800N	0774700W	100
IT	BFC	NAPLES	NAPLES	405000N	0141700E	101
IT	BOR	NAPLES	NAPLES	405000N	0141700E	102
ZZ	SAT	NATOIIIA	NATO IIIA			103
IC	TCF	NATOSITE	NATO SITE	620500N	0070200E	104
GR	BFC	NEAMAKRI	NEA MAKRI			105
36	CTD	NYORK CY	NEW YORK CITY	404000N	0735000W	106
51	BFC	NORFOLK	NORFOLK	365400N	0761800W	107
51	CIC	NORFOLK	NORFOLK	365400N	0761800W	108
51	NTE	NORFOLK	NORFOLK	365400N	0761800W	109
UK	NTE	OAKHANGR	OAKHANGER	504500N	0015000W	110
UK	CHD	OBAN	OBAN	553000N	0043500W	111
IT	CHD	PALO	PALO	415600N	0126000E	112
51	ZAZ	PENTAGON	PENTAGON	385000N	0770000W	113
51	CPA	PENTAGON	PENTAGON	385000N	0770000W	114
51	SVT	PENTAGON	PENTAGON	385000N	0770000W	115
51	OSS	PENTAGON	PENTAGON	385000N	0770000W	116
51	SWB	PENTAGON	PENTAGON	385000N	0770000W	117
51	NTS	PENTAGON	PENTAGON	385000N	0770000W	118
51	TBD	PENTAGON	PENTAGON	385000N	0770000W	119
51	ACA	PENTAGON	PENTAGON	385000N	0770000W	120
51	AWR	PENTAGON	PENTAGON	385000N	0770000W	121
51	CRY	PENTAGON	PENTAGON	385000N	0770000W	122
51	OCA	PENTAGON	PENTAGON	385000N	0770000W	123
51	IIC	PENTAGON	PENTAGON	385000N	0770000W	124
51	TCG	PENTAGON	PENTAGON	385000N	0770000W	125
GE	RRS	PIRMASNS	PIRMASENS	491200N	0073600E	126
GE	TCG	PIRMASNS	PIRMASENS	491200N	0073600E	127
42	SCA	POTTSTWN	POTTSTOWN	401500N	0754000W	128
GE	CST	RAISTNGS	RAISTINGS	475408N	0110659E	129
GE	SWB	RAMSTEIN	RAMSTEIN			130
GE	PTF	RHEINMAN	RHEIN MAIN	500158N	0083522E	131
IC	SWB	ROCKVILL	ROCKVILLE			132
TU	TCF	SAHINTPS	SAHIN TEPESI			133
FR	CHD	STHLRDRS	ST HILAIRE-DERIES	463100N	0030100E	134
ZZ	SAT	SATELLIT	SATELLITE			135
GE	TCG	SCHWTZGN	SCHWETZINGEN			136
17	CPA	SCOTT	SCOTT			137

Table A-14. Sites Contained in Data Base (Cont'd)

ST CRTY	FAC CODE	ABBREV NAME	LOCATION NAME	COORDINATES		NUMBER
BE	SPE	SHAPE	SPRM HQ ALD PWRS EUR			138
BE	SWB	SHAPE	SPRM HQ ALD PWRS EUR			139
GE	MRS	STCKSBRG	STOCKSBURG			140
GE	TCG	STUTTGRT	STUTTGART	484700N	0091200E	141
SA	CST	TAIF	TAIF	211334N	0403051E	142
IR	RCE	TEHERAN	TEHERAN	354200N	0512900E	143
IR	TCG	TEHERAN	TEHERAN	354200N	0512900E	144
IR	TXL	TEHERAN	TEHERAN	354200N	0512900E	145
GR	CST	THERMPYL	THERMOPYLAE			146
GL	AER	THULE	THULE	763400N	0684800W	147
34	CHD	TUCKERTN	TUCKERTON	393600N	0742000W	148
IR	DPC	TURKMNDH	TURKMAN DEH			149
IR	TCF	TURKMNDH	TURKMAN DEH			150
ZV	BCO	UNDTMNDL	UNDETERMINED LOC			151
ZV	CCE	UNDTMNDL	UNDETERMINED LOC			152
ZV	CCO	UNDTMNDL	UNDETERMINED LOC			153
ZV	NCY	UNDTMNDL	UNDETERMINED LOC			154
ZV	CCM	UNDTMNDL	UNDETERMINED LOC			155
GE	TCG	VAIHINGN	VAIHINGEN	484400N	0090600E	156
GE	WWN	VAIHINGN	VAIHINGEN	484400N	0090600E	157
11	GTY	WASHNGTN	WASHINGTON	385000N	0770000W	158
38	SCA	WHEATLND	WHEATLAND			159
36	GTY	WHITPLNS	WHITE PLAINS			160
UK	CHD	WIDEMOTH	WIDEMOUTH	504700N	0043300W	161
TU	TCF	YAMANLAR	YAMANLAR			162
0						

Table A-15. Link Identification

First Character: Type Link

Code	Meaning
B	HF
D	Diffraction radio
H	VHF/UHF point-to-point radio relay
K	Cable carrier
L	Leased (leased media, any type)
M	Microwave radio
Q	Submarine cable
R	Landline or cable (includes open wire)
S	Satellite relay
T	Forward Propagation Tropospheric Scatter

Second through Fifth Characters: Link Number Block Assignments

Code	Meaning
0000	Assigned to commercial links that do not meet the criteria for link number assignment
0001-0999	DCA Europe
1000-2999	DCA Pacific
3000-3999	Western Hemisphere
4000-4999	Headquarters, DCA
9000-9999	Not DCA controlled; our own number

Table A-16. Transmission Media

Code	Description
000	Unknown
C01	CANTAT Cable 1
C02	TAT 1 Cable
C03	TAT 2 Cable
C04	TAT 3 Cable
C05	ICECAN Cable
C06	SCOTICE Cable
C07	THULE Cable
C21	TAT 4 Cable
C36	TAT 5 Cable
C37	UK-Portugal Cable
C38	CANTAT Cable 2
C45	MAT-1 (Spain/Italy) cable
C48	UK-Spain (Bilbao) cable
C49	TAT 6 Cable
CAB	Government-owned cable nonloaded (onbase or offbase cable)
CML	Commercial lease (media not specified)
MX0	Microwave
NOS	Nonsimilar transmission media
SAH	Satellite Intelsat IV F3
SAJ	Satellite Intelsat IV F7
SWC	Satellite (NATO)
TS0	Tropospheric Scatter

Table A-17. Link Codes

First Character: Type of Link

Code	Description
C	Cable
M	Microwave
N	Not specified
S	Satellite
T	Tropo

Second Character is an alphanumeric character (0 - 9, A - N, P - Z) to uniquely identify the link.

APPENDIX B
TUTORIAL - FUNCTIONAL ELEMENTS OF A DATA BASE

B.1 FUNCTIONAL ELEMENTS OF A DATA BASE ARCHITECTURE

In this section, we present a brief description of the functional elements of which a data base architecture is composed. By presenting this tutorial section now, it will aid the reader unfamiliar with data base systems in understanding the detailed system descriptions for the INCA Data Base System. Included are the four major functional elements:

- Data Sets
- Links (pointers)/chains
- DBMS software package
- Applications

B.1.1 Early Information Systems

Up until a few years ago, data processing for all disciplines was characterized by multiple data sets, each developed for only one or a few applications. Often, many of the data elements of each data set were the same. Updating one data set meant updating for all data sets (that one knew of) which contained the updatable elements. Additionally, data sets were kept in the data order most suited for the given few applications. To use a related data set would mean preprocessing the data sets into a form and/or sort sequence suitable to the application. Consequently, the same data elements found in many data sets or files cost extra in storage costs, updating for one data set meant finding the other data sets with those elements, thereby incurring costs in extra processing and use of multiple, but differently organized data sets in an application execution or coding different I/O for each file. Additionally, programmers/analysts had to be aware of where each data set was, what was in it, and if such data sets were changed, programs had to be changed.

Large organizations, such as manufacturing concerns, began to feel the burden as computers became a major element in the organizational framework. Storage costs and processing costs required optimization for cost-effective data processing. Program changes had to be minimized, especially if there was significant programmer turnover. Effects of changing data sets on various applications had to be minimized or eliminated. Eventually, the concept of master data sets evolved in which data of a given type was kept. (e.g., payroll and personnel, parts, invoices, etc.). Multiple copies were not allowed. Standardization was enhanced by software which would access as many files as required for an application. Finally, in the evolutionary process, the concept of relating the data for efficient, rapid access was conceived, i.e., use pointers from an invoice number to records in the parts files and other pointers from invoices to customer account records, back-order records in their respective files. Now it was possible to read a customer record, follow a pointer from that record to another record which might be in the invoice file. Other pointers in this record of this data set would link to further invoice records so that each invoice could be found with only one disk access. Pointers in invoice records would link to records in the parts file to provide descriptive and pricing information such that parts descriptions and prices were kept in exactly one place and stored only once--in the parts file.

Maintenance of the chains of pointers (links) was crucial. To destroy one pointer in a chain was to lose the remainder of the chain and consequently destroy the value of the system. A software package to act as an interface between the user and the data set links (the complex of data sets and inter/intra-data set pointers/chains is now called a data base) was absolutely necessary and software firms began to produce such Data Base Management System packages (DBMS). With such a package, four objectives are immediately met. The data base with its critical element of record pointers is protected. Secondly, the programmer need only pass a data request list to the DBMS and receive back the data without knowledge or worry of how the data is stored or organized. Third, the data can be re-organized without changing the applications software (particularly the I/O areas) Fourth, a data element usually occurs only once, implying optimized storage costs and requiring only one place to update the element when it must be updated.

Other advantages become available and mean improved data processing, e.g., security through checking application software (users) right-to-know, control over who makes data changes, logs of transaction, organizational discipline over data quality since data is in one place under one management authority.

From the above, we see that application of a data base management system means application of two elements in the organization: a physical ordering of the data for cost-effective data processing operations and secondly, a philosophy of data management (i.e., data will be centralized, controlled and quality maintained by one management which will be held accountable).

B.1.2 <u>General Architecture of a Data Base System</u>

The tutorial now continues with discussion of the functional elements and illustrations of their relationships. The examples used will focus on part of the INCA Resources Data Base which is the data base system used to inquire about resources available such as codes, documents, contracts, etc. In addition, to just a single-level inquiry for information on say a company, one may want all INCA-related documents produced by that company, etc. This example will illustrate reduction in data storage costs and then show inter-relationships between records of different data sets.

B.1.2.1 Data Sets or Data Files

The terms data set and data file are used interchangeably and refer to the storage group of a set of related records, e.g., the document file would include all document records. In earlier times, one would have picked a major key category such as "contractor" and provided in the contractor record fields for name, address, document names, codes produced, etc. Continuation records might be used when additional fields must be filled in over and above what was originally allotted or variable length records might be employed.

In the newer data base technology, the data is divided into smaller files or data sets in which each file contains only information about one subject area: contractor file would contain only name and location and no reference to contract numbers, documents produced, etc.; the documents file contains only information about individual documents. In the latter example, company name would appear as the authorizing organization for the document. Figure B-1 illustrates the three data files of our example. It also shows that the contractor name and address appears as part of each record in each of the data files. Under contractors, it is the necessary and only record information or there would be no contractor file. In the remaining two files, it is required ancillary information, although redundant storage is required for the full name/address in each of three records. Any change would require accessing all three files for change consistency. One step of the data base design process is to identify such redundancies and replace the secondary element (in this case, name/address in Document and Data Set files) by a short pointer to the record in the Contractor file. Now there is exactly one place to update name and address information. Figure B-2 illustrates the pointers from the two data files to the Contractor file.

The next set of points would deal with relationships. Chains of pointers used here are primarily to speed up retrieval activity. Rather than select a contractor name and then search the entire documents file for those with that contractor name, the inquiry would specify "use contractor file to select a contractor and list all documents produced by him".

The data base (made up of the three data files) would be inter-linked with a pointer from the company record to the first document produced by the company. That document record would be retrieved (e.g., for printing) and then the pointer field in that document record would be examined. If end-of-chain indicator is present, there are no more documents for that contractor. If it is a valid pointer, then it points to another document record for that contractor elsewhere in the Documents file. After its retrieval, its pointer field is examined for end-of-chain indicator as before. When there are no more documents, the request for that contractor is satisfied. Another contractor is selected by the user

INCA DOCUMENTS

DOCUMENT NAME
CONTRACTOR NAME
CONTRACTOR ADDRESS
PERSONNEL CONTACT
NUMBER PAGES
CODE 1 EMPLOYED
CODE 2 EMPLOYED
CODE N EMPLOYED
DATA SET 1 EMPLOYED
DATA SET 2 EMPLOYED
DATA SET 3 EMPLOYED

INCA CONTRACTORS

CONTRACTOR NAME
CONTRACTOR ADDRESS
PERSONNEL CONTACT

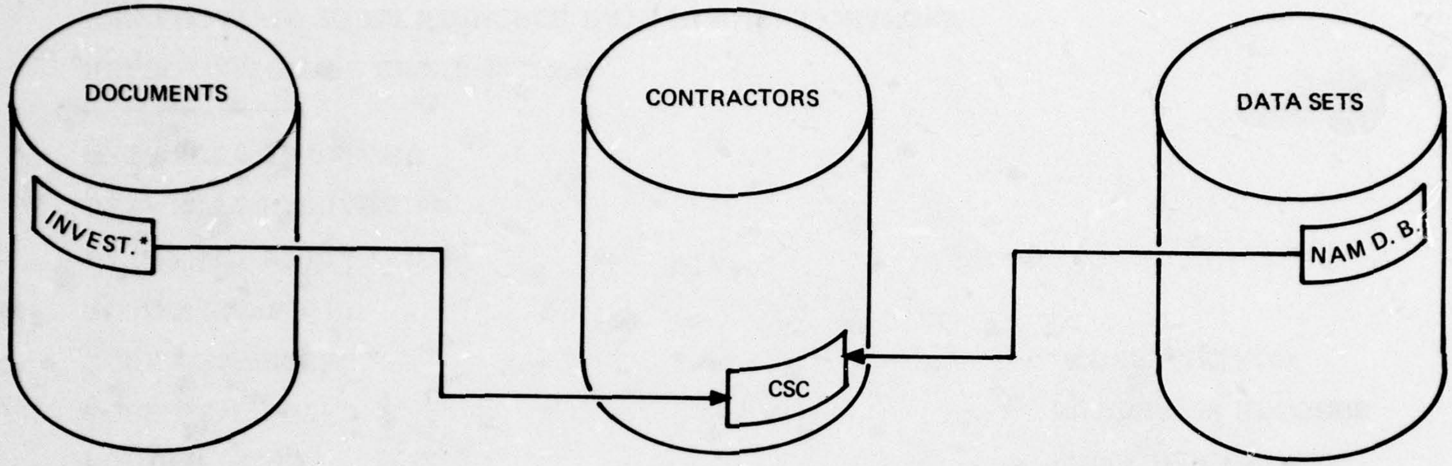
INCA DATA SETS

DATA SET NAME
CONTRACTOR NAME
CONTRACTOR ADDRESS
PERSONNEL CONTACT
BRIEF DESCRIPTION
NUMBER OF RECORDS
ACCESS METHOD

REDUCED STORAGE REQUIREMENT

ONE LOCATION TO MAINTAIN FOR DATA ELEMENT CHANGES

Figure B-1. Data Redundancy



* INVESTIGATION OF THE VULNERABILITY/SURVIVABILITY OF SYSTEMS SUPPORTING THE NCA DECISION PROCESS.

Figure B-2. Data Redundancy Elimination (Storage)

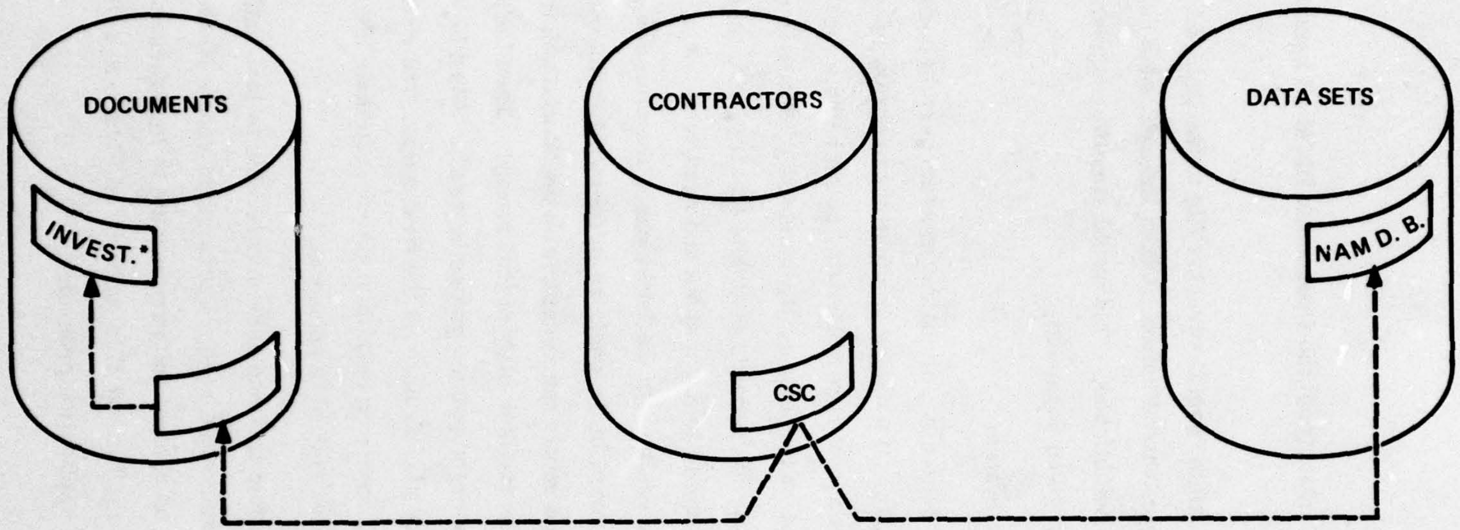
or the next contractor in turn is taken from the Contractor file if all contractors are to be processed.

A similar pointer system exists from Contractor file to the Data Sets owned by that contractor. Figure B-3 illustrates this situation. Other linkages such as from Document file to Data Sets file can also be established. This would simplify requests of the form of "give all data sets related to a given document.

B.1.2.2 Data Base Management System

Having created a data base with a set of chains presents certain porblems in the efficient utilization of the data base. If a user's applications program is to operate with the data base, he must be aware of record layouts, pointer chain locations in each record, nature of the end-of-chain pointer, the numbers of chains and how to manage them, especially if he will add records or delete them. Also, there is a problem of someone else attempting to follow a chain and read/write data in records as the first user is modifying the chains. In the latter case, the situation could arise where the second user reads a record in the chain he is following (pointers included), updates a value, but before he can return the record (with unchanged pointers), the first user modifies the pointers on the disk copy of that record. Then the second user gets to return the record (with the pointer values he read). When he does so, he wipes out the new chain pointer placed there by the first user. The chain is now defective since the pointer values have erroneously been reset to their old values and the record may not point to the next record in sequence.

Other problems include the fact that one user may be able to lock out other users if he does not promptly return a record he read. Users might update fields they have no authority to update. There is no central software module to log transactions for use in bringing up a crashed data base. The left side (bottom) of Figure B-4 illustrates the direct use of the data base by application programs.



* INVESTIGATION OF THE VULNERABILITY/SURVIVABILITY OF SYSTEMS SUPPORTING THE NCA DECISION PROCESS.

Figure B-3. Data Relationships

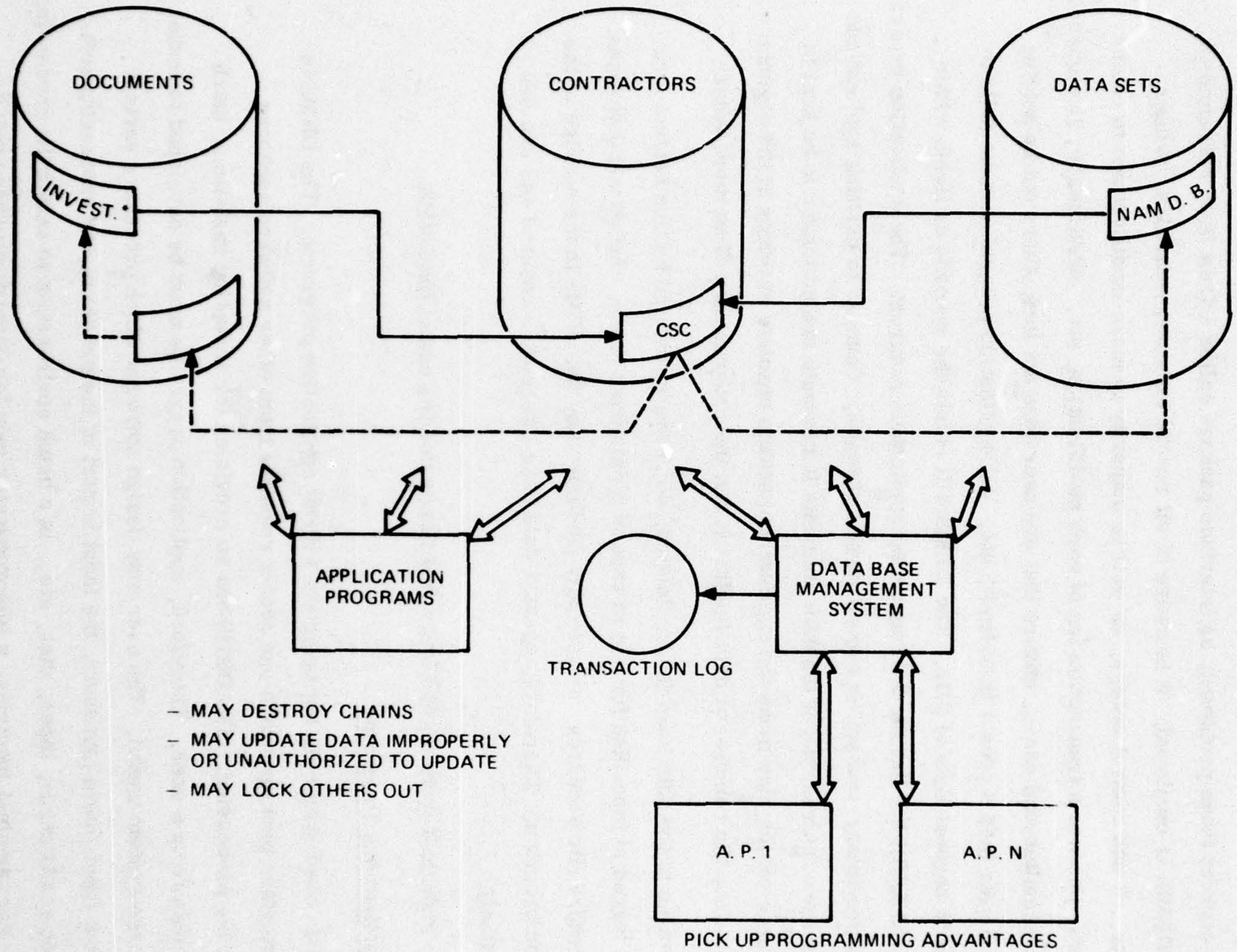


Figure B-4. Data Base Management System

To correct these problems, an interface package called a Data Base Management System (DBMS) is employed. It is aware of all record formats, data files, pointer fields, etc. It can control access, as well as authority to make modifications to chains of pointers, produce a transaction log of each modification, etc. Additionally, it sequences multiple, simultaneous users, ensure that one user does not lock others out by holding a record longer than a preset time limit, etc. All application programs make calls to the DBMS to request lists of data. The DBMS will obtain the records or fields within records and fulfill the list for the requesting application program. The application program is insensitive to any data set or record format changes. Changes to existing applications programs are required only if the data elements it requests are no longer to be kept in the data base (which may make the application package obsolete in terms of the organization work since the removal of data implies it and the program are of no more value).

Changes to the data base (adds, deletes, etc.) are monitored by this central focal point and logged to tape/disk for use in case of a data base crash. All physical changes, like the read/write accesses, are actually performed by the DBMS in the service of the application program. Therefore, greater data base integrity is ensured and crashes are less likely.

The right half (bottom) of Figure B-4 illustrates the use of the DBMS.

B.1.3 Applications Programs

A data base system is not complete without application programs. The DBMS is only an interface package which can accept requests from other software packages for data base processing. The DBMS has no provision for accepting real-time, batch or RJE inputs from a user. Therefore, application programs must be developed to make the data base system useful. The user may design software which processes certain data without input (more precisely, the input is part of the program), or processing software which reads cards, tapes, disk, etc., in a batch environment to select the processing desired. For terminal inquiries, a teleprocessing monitor/inquiry package must be provided.

These are generally the responsibility of the user. Some vendors of DBMS do offer generalized report writers and teleprocessing/inquiry packages for the user who finds these will fit his application.

Application programming, when using a DBMS, is greatly simplified relative to file description file/record format layout coding and I/O coding. There is no analysis or system planning required to set up files--the DBMS controls the already optimally established data files/data base. Coding of records layouts and field data element attributes is eliminated for the most part--DBMS has such attributes already established. I/O coding requires only passing a list of data elements desired and the DBMS finds the data-no programmer coding to access and search for desired data. Records related to the retrieved data (e.g., documents related to a retrieved contractor) can be rapidly retrieved from the second file without the programmer having to perform the file search. If the data base organization is changed to reflect the addition of new files, data element interchanges between records, record layouts modified, the application programs generally need no modification, since record layouts, file descriptions are not coded in programs using a DBMS. As long as the data is available and the DBMS remains unchanged (with regard to the interface between the DBMS and application programs), application software is insensitive to physical data file/data base changes.

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